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GAEUMANNOMYCES, *LINOCARPON*, *OPHIOBOLUS* AND SEVERAL OTHER GENERA OF SCOLECOSPORED ASCOMYCETES AND *PHIALOPHORA* CONIDIAL STATES, WITH A NOTE ON HYPHOPODIA

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SUMMARY

The genera *Acanthophiobolus* Berlese, *Acanthotheciella* v. Höhn., *Cylindrina* Pat., *Dilophia* Sacc., *Exilispora* Tehon & Daniels, *Gaeumannomyces* v. Arx & Olivier, *Lidophia* Walker & Sutton, *Linocarpon* H.& P. Sydow, *Microstelium* Pat., *Ophiobolus* Riess, *Ophiochaeta* (Sacc.) Sacc.,*Ophiosphaerella* Speg.,*Ophiosphaeria* Kirschst., *Ophiotrichia* Berlese and *Schizacrospermum* P. Henn. are described and discussed on the basis of their type specimens. *Gaeumannomyces* is re-defined as a hyphopodiate genus. *G. caricis* n. sp. on *Carex* and *Ophiosphaerella erikssonii* n. sp. on *Calamagrostis* are described. New combinations are made in the genera *Leptospora* Rabenh., *Lophodermium* Chev., *Ophioceras* Sacc., *Ophiosphaerella* Speg., *Phialophora* Medlar, *Plagiosphaera* Petrak and *Sphaerulina* Sacc.. Several other species in the above genera and in *Lasiosphaeria* Ces. & de Not., *Leptosphaeria* Ces. & de Not., *Leptosphaeriopsis* Berlese, *Leptosporopsis* v. Höhn., *Linospora* Fckl., *Phaeosphaeria* Miyake, *Rhaphidophora* Ces.& de Not., *Rhaphidospora* Fr. & Mont., *Sphaeria* Haller ex Fr. and *Winterella* auct. are also considered. *Phialophora radicicola* Cain is described from its type specimen and culture, and related *Phialophora* spp. and conidial states of *Gaeumannomyces* are considered. The use of the terms hyphopodium and appressorium for some organs of attachment and penetration is discussed.

INTRODUCTION

During work on the taxonomy of the cereal take-all and related fungi (Walker, 1972, 1980), type specimens and other collections of several genera of scolecospored perithecial and pseudothecial fungi have been examined. Descriptions of some of these have been included (Walker, 1980) in a book dealing with the biology and control of take-all (Asher and Shipton, 1980) but this does not include taxonomic detail, no specimens are listed and several genera unconnected with take-all are not included.

The aim of the present paper is to provide taxonomic and specimen details for the genera and species included in Walker (1980) and to give similar information and detailed descriptions for several other genera and species not dealt with there. Details are also included for *Phialophora* conidial states of *Gaeumannomyces*, and related *Phialophora* spp., and a short discussion on the use of the term hyphopodium for hyphal organs of attachment and penetration in these fungi is given. Genera are considered in alphabetical order, and synonyms are cross-referenced in the text. Herbarium abbreviations used are those of Holmgren and Keuken (1974, 1976, 1977, 1978). The symbol ! after a herbarium abbreviation indicates that type material from that herbarium has been studied. Publication dates for some earlier references and, in particular, for the various pages and parts in the four volume Icones Fungorum by A.N. Berlese, are taken from Stafleu and Cowan (1976). Indices under specific epithet, and host or substrate, are given at the end.

Frequent reference is made, especially under *Gaeumannmyces*, *Ophiosphaerella*, *Phaeosphaeria* and *Phialophora* to Walker (1980) where details not repeated here will be found. The various chapters in Asher and Shipton (1980) give details of the biology and pathology of *Gaeumannomyces graminis* and its varieties, and also an extensive bibliography on all aspects of the cereal take-all diseases and the associated fungi.

It is possible that the name *Phialophora graminicola* (Deacon) Walker, published formally as a new combination in the present paper, may be found already in papers by other authors dealing with cereal root fungi, especially S.D. Garrett and J.W. Deacon. Use of the name in such papers is provisional, pending its formal publication in this paper. This is mentioned in order to avoid any confusion at a later date about the publication date of this binomial.

ACANTHOPHIOBOLUS

Acanthophiobolus Berlese, separate from *Atti del Congresso Bot.Int.*, Genova, pp.4-5, 1892 (see note below about date) Type sp. *A. helminthosporus* (Rehm) Berl.
≡ *Ophiotrichia* Berlese, *Icon. fung.* **1**, 105, Jan.1893 (not validly published; based on *Leptospora helminthospora* Rehm, as *Acanthostigma helminthosporum* (Rehm) Sacc., see discussion under *Ophiotrichia*).
≡ *Ophiochaeta* (Sacc.) Sacc., *Syll. Fung.* **11**, Pt. 3, 352, 1895.
Lectotype sp. *O. gracilis* (Niessl) Sacc.
= *Ophiosphaeria* Kirschstein, *Verh.Bot. vereins Prov. Brandenb.* **48** (1906), 47-48, 1907.

Type sp. *O*. *tenella* Kirschst.

Berlese (1892) erected his new genus for *Leptospora helminthospora* Rehm (1882), originally described on rotting cloth from Augsburg, West Germany. He also included several species placed by Saccardo (1883) in *Ophiobolus* subgenus *Ophiochaeta*. *Acanthophiobolus* was distinguished from *Ophiobolus* by superficial perithecia, ornamented especially on their upper surface with black, rigid divergent setae. This was the character that Saccardo (1883) had used for his subgenus *Ophiochaeta*. In contrast to this, Berlese (1892) removed the setose species from this subgenus to *Acanthophiobolus* and retained in subgenus *Ophiochaeta* those species attached to a meandering basal mycelium and he designated *Ophiobolus herpotrichus* as the subgeneric type. Further discussion of this and of the confusion surrounding the name *Ophiochaeta* is given below under that name.

A study of the types of several species has shown that they cannot be distinguished and should be placed in the one species of *Acanthophiobolus*. The earliest epithet found so far for this species comes from *Sphaeria helicospora* Berk. & Br. (1852). A description and illustration of the specimens of *S*. *helicospora* in K were given by Walker (1972) and a partial synonymy proposed. A more extensive synonymy and detailed description, with list of specimens examined is given here.

Acanthophiobolus helicosporus (Berk.& Br.) Walker, *Trans*. *Brit*. *mycol*. *Soc*. *58* (3), 445, 1972.

- ≡ *Sphaeria helicospora* Berk. & Br., *Ann*. *Mag*. *Nat*.*Hist*. ser.2, *9*, 383, 1852 (type in K !)
- ≡ *Ophiobolus helicosporus* (Berk.& Br.) Sacc.,*Syll*.*Fung*. *2*, 350, 1883.
  - = *Sphaeria chaetophora* Crouan, in Crouan & Crouan, *Fl*. *Finist*. 26, 1867 (type in CO !)
    - ≡ *Ophiobolus chaetophorus* (Crouan) Sacc., *Syll*. *Fung*. *2*, 353, 1883.
    - ≡ *Ophiochaeta chaetophora* (Crouan) Sacc., *Syll*. *Fung*. *11*, Part 3, 352, 1895.
    - ≡ *Ophiosphaeria chaetophora* (Crouan) Kirschst.,*Ann*. *Mycol*. *34*, 198, 1936.
- = Lasiosphaeria *gracilis* Niessl, *Notizen über neue und kritisch*. *Pyrenomyc*., p.36, 1876 (type in M !)
    - ≡ *Acanthostigma gracile* (Niessl) Sacc., *Syll*. *Fung*. *2*, 210, 1883.
    - ≡ *Ophiochaeta gracilis* (Niessl) Sacc., *Syll*. *Fung*. *11*, Part 3, 352, 1895.
    - ≡ *Ophiosphaeria gracilis* (Niessl) Kirschst.,*Kryptogamenfl*. *Mark Brandenburg* *7* (2), 204, 1935 (original not seen; from Müller, 1952).
    - ≡ *Ophiobolus gracilis* (Niessl) Müller, *Ber*. *schweiz bot*. *Ges*. *62*, 336, 1952.
    - ≡ *Acanthophiobolus gracilis* (Niessl) v.Arx & Müller *Studies in Mycology* (Baarn) No.9, 83, 1975.
- = *Leptospora helminthospora* Rehm, *Hedwigia* *21*, 122,

1882, (type in S !)
≡ *Acanthostigma helminthosporum* (Rehm) Sacc., *Syll. Fung.* **2**, 210, 1883 (Saccardo incorrectly gives '*Lasiosphaeria*' *helminthospora* Rehm as the basionym)
≡ *Acanthophiobolus helminthosporus* (Rehm) Berlese, separate from *Atti del Congresso Bot. Int.*, Genova, pp.3-5, 1892.
≡ *Ophiochaeta helminthospora* (Rehm) Sacc., *Syll. Fung.* *11*, Part 3, 352, 1895.
= *Ophiosphaeria tenella* Kirschst., *Verh. Bot. vereins Prov. Brandenb.* *48* (1906), 47-48, 1907 (type in B !)

(*Comments on names:* (i) Berlese (1892) included *Lasiosphaeria gracilis* Niessl, *Sphaeria chaetophora* Crouan and *Rhaphidophora incompta* Car. & de Not. in *Acanthophiobolus* but did not make new combinations in *Acanthophiobolus* for these epithets. (ii) Müller (1952) placed *Ophiochaeta cladii* Cruchet (1923) on *Cladium mariscus* (L.) Pohl as a synonym of *Ophiobolus gracilis* after study of the Cruchet collection, but did not mention the spirally arranged ascospores. Cruchet's specimen has not been studied during the present work so *O. cladii* is not listed formally in synonymy here, although it is probably *A. helicosporus* (for several collections on *Cladium mariscus*, see below). (iii) In the literature, the name '*Lasiosphaeria helminthospora* Rehm' has also been seen but Rehm (1882) described his species as *Leptospora helminthospora* and I could find no evidence of publication of the *Lasiosphaeria* name. As Holm (1957) pointed out when discussing *Leptospora*, there was some confusion in the earlier literature regarding *Leptospora* and *Lasiosphaeria*. (iv) On the label of *Sphaeria helicospora* Berk. & Br. issued as *F. europ.* 141, Rabenhorst noted that he considered it a new genus, but apparently he never described it).

Ascocarps superficial, globose to subglobose to broadly conical, often with flattened base, dark brown to black, 150-300 µm diam, with rigid, dark brown to black setae, especially on their upper half; wall thin, of 3-6 layers of cells, outer layer a textura angularis of cells 10-20 µm diam with thin brown walls, cells smaller around the ostiole and tending to be arranged concentrically around it in some collections; ostiole 25-40 µm diam; setae arising from dark brown cells in ascocarp wall, 7-15 µm wide at the base and tapering to a rounded, paler apex 2-4 µm wide, septate, variable in length, many 150-250 (300) µm, amongst these several forming a shorter series 80-120 µm long, ostiole surrounded by 10-20 short, dark brown, conical setae, with obtuse or acute apex, 10-14 µm wide at base, 4-6 µm at apex, 25-35 (45) µm long, projecting inwards over the ostiole (Fig.1), setae sometimes with a short narrowed zone 10-20 µm behind apex, seta wall 2.5-3 µm thick near base. *Asci* long cylindrical to elongated clavate, bitunicate, 110-165 x 7-10 µm, narrower near base, asci of variable length and maturity seen in the one ascocarp, apex rounded and slightly thickened, apical apparatus not seen, base foot-like, eight-spored. *Ascospores* tightly coiled in a dense spiral, direction of spiral clockwise viewed from apex of ascus, hyaline to faintly yellowish in mass, 1.5-2 µm wide, as long as or slightly longer than the asci but due to dense spiralling length not determined accurately, estimated at about 160 µm in an ascus 130-140 µm long. *Pseudoparaphyses* abundant, hyaline, filiform, of variable diameter and often showing several slightly swollen bumps along their length, (1) 1.5-2 (2.5) µm wide, longer than the asci. *Superficial mycelium* sparse, surrounding and joined to base of ascocarp, of hyaline to pale brown septate hyphae, septa not prominent or abundant, branching and fusing into a loose reticulum or thin sheet, hyphae 2.5-5 µm diam, non-hyphopodiate.

On dead leaves, leaf sheaths, stems and inflorescence stalks of various, mainly monocotyledonous, plants in damp places, especially but not exclusively Cyperaceae and Gramineae, and on cloth; probably common in temperate areas.

Illustrations: Berlese (1892, setose ascocarp, ascus, ascospores; 1890-1900, Vol.2, as *Ophiochaeta helminthospora*, habit, setose ascocarp, ascus, ascospores); Dennis (1968, as *A. helminthospora*, setose ascocarp, ascus with spores); Kirschstein (1907, as *Ophiosphaeria tenella*, habit, setose ascocarp, ascus, ascospores); Walker (1972, ascocarps, asci, spiralled ascospores).

Specimens examined: On *Carex acutiformis* Ehrh., Surlingham Broad, Norfolk, England, 15.vi.1944, E.A. Ellis, IMI 16728b; Flatford Mill, Suffolk, England, 9.v.1948, J.P.Morgan, IMI 28563a (both as '*Ophiosphaeria gracilis*').

On *Carex elata* All., Flatford Mill, Suffolk, England, 9.v.1948, M.B. Ellis 28566a (as '*Ophiosphaeria gracilis*').

On *Carex paniculata* L., Le Vallon, France, date not given, in CO, HOLOTYPE of *Sphaeria chaetophora* Crouan (slides as DAR 33711); Batheaston, England, 7.vi.1867 (or 1869?), in Herb. Berkeley in K (slide as DAR 33712); Wiltshire, England, April 1859, C.E. Broome, Rabh. *F. Europ*. 141, dups. in K, L and UPS (as *S. helicospora*).

On *Carex pendula* L., Moccas Park, Hereford, England, no date, M.B. Ellis, IMI 47041 (as '*Ophiosphaeria gracilis*').

On *Carex riparia* Curt., Rathenow, Germany, 9.v.1905, W. Kirschstein, in B, LECTOTYPE of *Ophiosphaeria tenella* Kirschst., see below (slides as DAR 32150); Wheatfen Broad, Norfolk, England, 28.iii.1948, M.B. Ellis, IMI 27781; same, 25.v.1946, IMI 34659; same, 29.v.1950, IMI 42024; Half Moon Island, Hickling Broad, Norfolk, England, M.B.and J.P. Ellis, IMI 34857 (all IMI collections as '*Ophiosphaeria gracilis*').

On *Cladium mariscus* (L.) Pohl, all from Wheatfen Broad, Norfolk, England; 10.v.1947, E.A. Ellis, IMI 15413 (as '*Ophiochaeta* sp.'); 17.viii.1947, E.A. and M.B. Ellis and R.W.G. Dennis, IMI 17329; 8.ii.1948, E.A. Ellis, IMI 34392; 25.v.1948, E.A. Ellis, IMI 34588; 1.viii.1949, E.A. Ellis, IMI 36147 (all as '*Ophiosphaeria gracilis*').

On Cyperaceae, undet., sheet in K with three packets (a) on *Carex paniculata* (see above) (b) No.197, Spye Park, 19.iv.1850, LECTOTYPE of *Sphaeria helicospora* Berk. & Br. (see below), with drawing of asci and spiralled ascospores (slides as DAR 33713) (c) labelled '*Sphaeria helispora* B. & Br.' and stamped 'Herb. Berk. 1879' (slide as DAR 33714); Spye Park, Wiltshire, March 1863, C.E. Broome, in UPS (as '*Sphaeria helicospora* B. & Br.').

On *Glyceria maxima* (Hartm.) Holmb., Wheatfen Broad, Norfolk, England, 13.v.1945, E.A. Ellis, IMI 17404b (slide only showing setose ascocarps and asci with spiralled ascospores); Flatford Mill, Suffolk, England, 7.v.1948, J.P. Morgan, IMI 28561 (both as '*Ophiosphaeria gracilis*').

On *Iris pseud'acorus* L., Kootheimer Teich, Brünn, Germany, July

1874, Niessl, in M, LECTOTYPE of Lasiosphaeria gracilis Niessl, see below (slides as DAR 33702); Rastatt, Germany, 20.viii.1875,Schroeter, in M (slides as DAR 33703).

On Juncus subnodulosus Schrank, Wheatfen Broad, Norfolk, England, 26.v.1947, E.A. and M.B. Ellis, IMI 15470b.

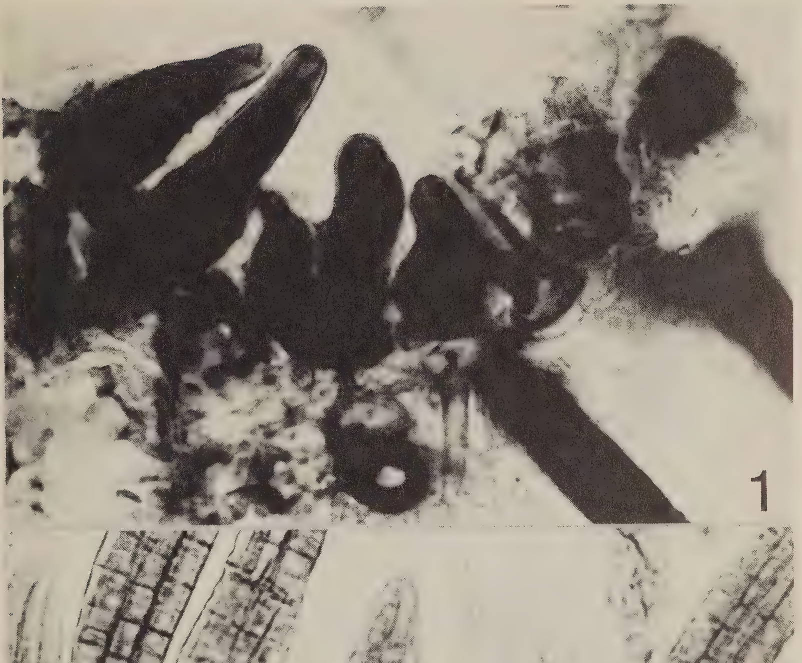
On Lepidosperma sp., Amiet's Track, near Laver's Hill, Victoria, Australia, 14.xi.1965, G. Beaton, IMI 116204 (as 'Ophiochaeta sp.'); first Australian record.

On Phragmites australis (Cav.) Trin. ex Steud. (as P. communis), Wheatfen Broad, Norfolk, England, 29.v.1950, M.B. Ellis, IMI 42032 (as 'Ophiosphaeria gracilis').

On rotted cloth, Augsburg, Germany, 14.ii.1880, M. Britzelmayr, in S, HOLOTYPE of Leptospora helminthospora Rehm (slides as DAR 33283).

Lectotypification is necessary for some of the names. In describing Sphaeria helicospora, Berkeley and Broome (1852) did not quote a definite collection, but stated 'On leaves of Cyperaceae, West of England'. From the material available in K, the small sheet numbered 197, marked 'Spye Park' and dated '19.iv.1850', showing the fungus as described above and with a drawing of an ascus with densely spirally arranged ascospores (figured in Walker, 1972) is chosen as LECTOTYPE of the name Sphaeria helicospora Berk. & Br.. It is the only collection seen which predates publication of the name and Spye Park is a country seat, 4 miles S.W. of Calne, Wiltshire, in the west of England (Bartholomew, 1943). In his original description, Kirschstein (1907) mentioned two collections of Ophiosphaeria tenella, on Glyceria spectabilis M. & K. and Carex riparia at Gross-Behnitz and Rathenow, in June 1904, and in 1905 but neither was listed as type. The collection in B labelled 'Ophiosphaeria tenella WK. Nv. sp. et. gen.' in Kirschstein's writing, on Carex riparia, Rathenow, 9.v.1905 with red sticker, is designated LECTOTYPE of the name Ophiosphaeria tenella Kirschst.. In describing Lasiosphaeria gracilis, Niessl (1876) listed two collections on Iris pseud'acorus from Brünn and Rastatt. The Brünn collection in M, labelled 'Lasiosphaeria gracilis n.s.' collected in July 1874 is chosen as LECTOTYPE.

The exact date of publication of Acanthophiobolus Berlese could not be determined from available sources. A copy of a separate from Atti del Congresso Botanico Internazionale Genova 1892 in the library of the Commonwealth Mycological Institute has pages numbered 1-10, one plate labelled 'Tab. xxii' and is dated at the end of the text 'Agosto 1892'. Acanthophiobolus is described on p.4. Saccardo (1895) in listing Acanthophiobolus as a synonym of Ophiochaeta (Sacc.) Sacc., gives its year of publication as 1892. In contrast, Clements and Shear (1931) and von Arx and Müller (1975) list it as published on p.571 of the Atti in 1893, and Lindau and Sydow (1908) cite the Berlese article on pp.567-576 of the Atti in 1893. It is not known whether the separate of the Berlese article dated August



Figures 1 and 2. 1. *Acanthophiobolus helicosporus*, short ostiolar setae and bases of long wall setae, x 733, from lectotype of *Lasiosphaeria gracilis* in M (slide DAR 33702). 2. *Leptosphaeria compressa*, asci and ascospores, x 733, from holotype of *Exilispora plurisepta*, ILLS 8404 (slide DAR 33733).

1892 was issued prior to the publication of the *Atti* in 1893. If it was, then August 1892 can be accepted as the date of publication of *Acanthophiobolus* Berlese (Art.30). If not, the date will be that in 1893 when the *Atti* were issued. The fact that Saccardo (1895) gave the 1892 date indicates that some printed matter may have been available then and the 1892 date has been used here.

Several authors recognised the close relationship between the species here reduced to synonymy under *A. helicospora*. Kirschstein (1907) commented on the similarity of *Lasiosphaeria gracilis* Niessl to his *Ophiosphaeria tenella* and, although no new combination was made at that time, suggested that Niessl's species be placed in *Ophiosphaeria*. Höhnel (1907) placed *O. tenella* in synonymy with Crouan's *Sphaeria chaetophora* as *Ophiochaeta chaetophora*. Weese (1921) commented on the extraordinarily close relationship between *Leptospora* (as *Lasiosphaeria*) *helminthospora* Rehm, *Lasiosphaeria gracilis* Niessl and *Ophiobolus chaetophorus* (Crouan) Sacc. and regarded them as species of *Acanthophiobolus*. Kirschstein (1936) agreed that *O. tenella*, *S. chaetophora* and *L. gracilis* were the same and reduced all to synonymy under *Ophiosphaeria chaetophora*. Malbranche and Niel (1890) noted the spiral arrangement of ascospores in *S. helicospora* and the similarity with *S. chaetophora* Crouan, but also noted that Berkeley and Broome (1852) had not mentioned setae in their original description of *S. helicospora*. Walker (1972) examined the collections of Crouan and of Berkeley and Broome, described and illustrated the setose ascocarps and spiralled ascospores, and showed that *S. helicospora* provided the earliest name for this fungus.

The collections of *A. helicosporus* examined came mainly from England and Europe, with one from Australia. It is perhaps more widespread than these collections indicate and may be a common saprophyte on dead leaves of Cyperaceae, to a lesser extent Gramineae and other monocotyledons and occasionally on textiles of plant origin. It seems to occupy an ecological position similar to that of some species of *Chaetomium*, another genus with appendaged ascocarps.

ACANTHOSTIGMA

Acanthostigma gracile (Niessl) Sacc. = *Acanthophiobolus helicosporus* (q.v.).

ACANTHOTHECIELLA

Acanthotheciella Höhn., *Sitzungsber.Akad.Wiss.Wien* **120**, 451, 1911

Type sp. *A. barbata* (Pat. & Gaill.) Höhn. (as '(Pat.) Höhn.')

≡ *Ophiobolus barbatus* Pat. & Gaill., *Bull. Soc. Mycol. Fr.* **4**, 114-115, 1888 (type in FH !)

≡ *Ophiochaeta barbata* (Pat. & Gaill.) Sacc.,*Syll.Fung.* **11**, Part 3, 352, 1895.

A full description and illustration of this and other species of Acanthotheciella and their Ypsilonia conidial states was given by Nag Raj (1977). Study of the type and other collections of A. barbata confirm his observations. Acanthotheciella is characterised by superficial dark glabrous, tuberculate or setose perithecia, seated on a pseudoparenchymatous hypostroma with surrounding mycelium, and containing aparaphysate unitunicate asci with hyaline to faintly pigmented scolecospores. It is associated with an Ypsilonia conidial state (Nag Raj, 1977). The known species occur on dead scale insects. Saccardo (1895) and Berlese (1900) listed O. barbata amongst the species they placed in Ophiochaeta (q.v.).

Illustrations: Nag Raj (1977, ascocarps, asci, ascospores, conidial state).

Specimens examined: sur écorce, Atures, Venezuela, July 1887, Herb. N. Patouillard No. 91, FH, HOLOTYPE of O. barbatus (slide as DAR 33715; only conidia seen); Puente de Chimbo, Venezuela, August 1891, Lagerheim, Patouillard sheet 5984 in FH (slides as DAR 33716; perithecia, asci, ascospores and conidial fructifications present); ad corticem arbor. frond., S. Leopoldo, Rick, no date, Patouillard sheet 5984 in FH (slide as DAR 33717; only conidia seen, possibly an aberrant form of A.barbata, see comments by Nag Raj, 1977).

COCHLIOBOLUS

The genus Cochliobolus Drechsler (1934) is not considered in this paper. Incidental mention of the genus is made under Leptospora, Ophiobolus heterostrophus and O.zeae.

CYLINDRINA

Cylindrina Patouillard, Bull. Soc. Bot. Fr.33,155-156, 1886.
Type sp. C. delavayi Pat. (type in FH !)

Originally collected on dead leaves of Liparis liliiflora Reich. in Yunnan, China, Cylindrina delavayi was described with sparse smooth black cylindrical perithecia 1-2 mm high, with a truncated cupulate apex containing a circular, sometimes widely opened, ostiole, and very long thin asci 300-350 x 6-7 µm containing filiform continuous ascospores as long as the ascus. Paraphyses were described as linear. The genus was considered close to Acrospermum Tode. Arnaud (1912) noted the similarity of the descriptions of C. delavayi and Acrospermum parasiticum Syd. in Sydow & Butler (1911) (on leaf spots of Heptapleurum venulosum (Araliaceae), India) and concluded that Acrospermum and Cylindrina were closely similar genera. Ainsworth (1971), following Arnaud (1912), listed Cylindrina Pat. as a synonym of Acrospermum. Sherwood (1977, p.142) reduced Cylindrina to synonymy under Stictis Pers.. She commented on the sparse nature of the type collection and gave a brief description.

The type specimen is minute, consisting of a fragment of leaf with one fruiting body. This is slightly less than 1 mm high and roughly 0.8 mm diam, black, circular in cross section, hollow, with its base embedded in the leaf tissue and a circular apical pore. The fruiting body is somewhat shorter than originally described and examination indicated that its apex may have been cut off at some stage. In view of the scarcity of the material, no slides were made. I doubt that it would be possible to categorise *Cylindrina* Pat. from this collection and would regard the synonymies suggested by Ainsworth (1971) and Sherwood (1977) as tentative. This generic name should not be used for later collections.

Specimen examined: on leaf of *Liparis liliiflora*, Yunnan, China, no date on label, Abbé Delavay, Herb. Patouillard 7226, in FH, HOLOTYPE of *C. delavayi* (a second label printed 'Herbarium Francavillanum' on which is written '*Cylindrina delavayi* Pat.' is included with the specimen).

DILOPHIA

Dilophia Sacc., *Syll. Fung*. 2, 357, 1883 (Sphaeriaceae), non *Dilophia* T. Thompson, *Hooker's J.Bot*. 5, 19, 1853 (Cruciferae).
Type sp. *D. graminis* Sacc. (Type in G!).

Dilophia Sacc. is a later homonym of *Dilophia* Thompson. The new generic name *Lidophia* Walker & Sutton (1974) was proposed for it (q.v.).

EXILISPORA

Exilispora Tehon & Daniels, *Mycologia* 19, 113, 1927
Type sp. *E. plurisepta* Tehon & Daniels (Type in ILLS !)

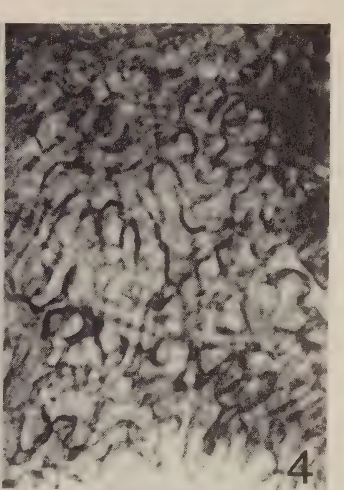
Petrak (1941) considered *Exilispora* as a synonym of *Ophiobolus* Riess. von Arx and Müller (1975) reduced it to synonymy with *Leptosphaeria* Ces. & de Not. and transferred the type (and only) species as *L. plurisepta* (Tehon & Daniels) von Arx & Müller. Study of the type specimen confirms its placement in *Leptosphaeria*, but it is considered to be not distinct from *L. compressa* (Rehm) Holm (see description under this name).

GAEUMANNOMYCES

Gaeumannomyces von Arx & Olivier, *Trans.Brit. mycol. Soc.* 35 (1), 29-33, 1952.
Type sp. *G. graminis* (Sacc.) von Arx & Olivier
≡ *Rhaphidophora graminis* Sacc., *Nuovo Giorn.bot.ital*. 7, 307-308, 1875.

Figures 3 - 7. *Gaeumannomyces*. 3 and 4. *G. graminis* var. *graminis*, external wall layer of perithecium, x 733, from holotype in PAD (slide DAR 21032). 5 and 6. *G. caricis*, asci and ascospores, x 183, from holotype in C (DAR 32062). 7. *G. caricis*, associated hyphopodia, x 733, from holotype in C (slide DAR 32062)

3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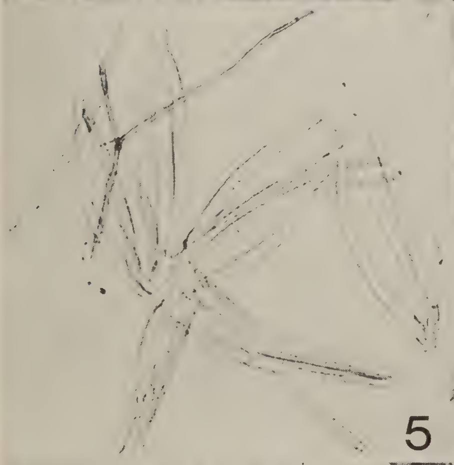
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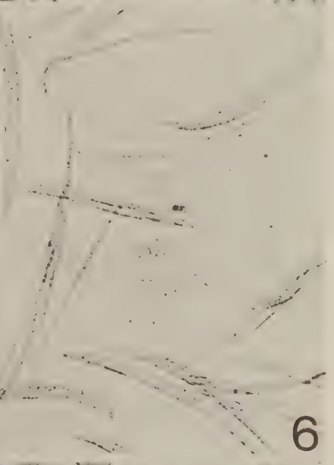
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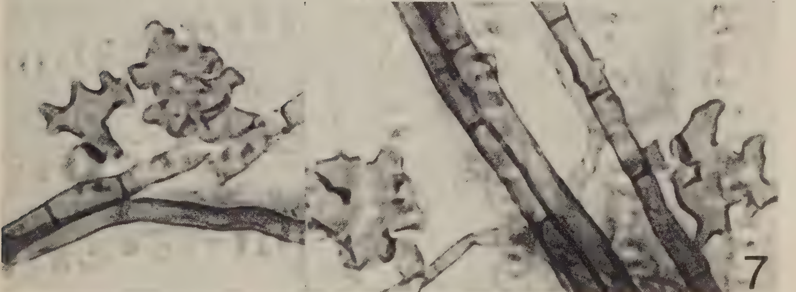
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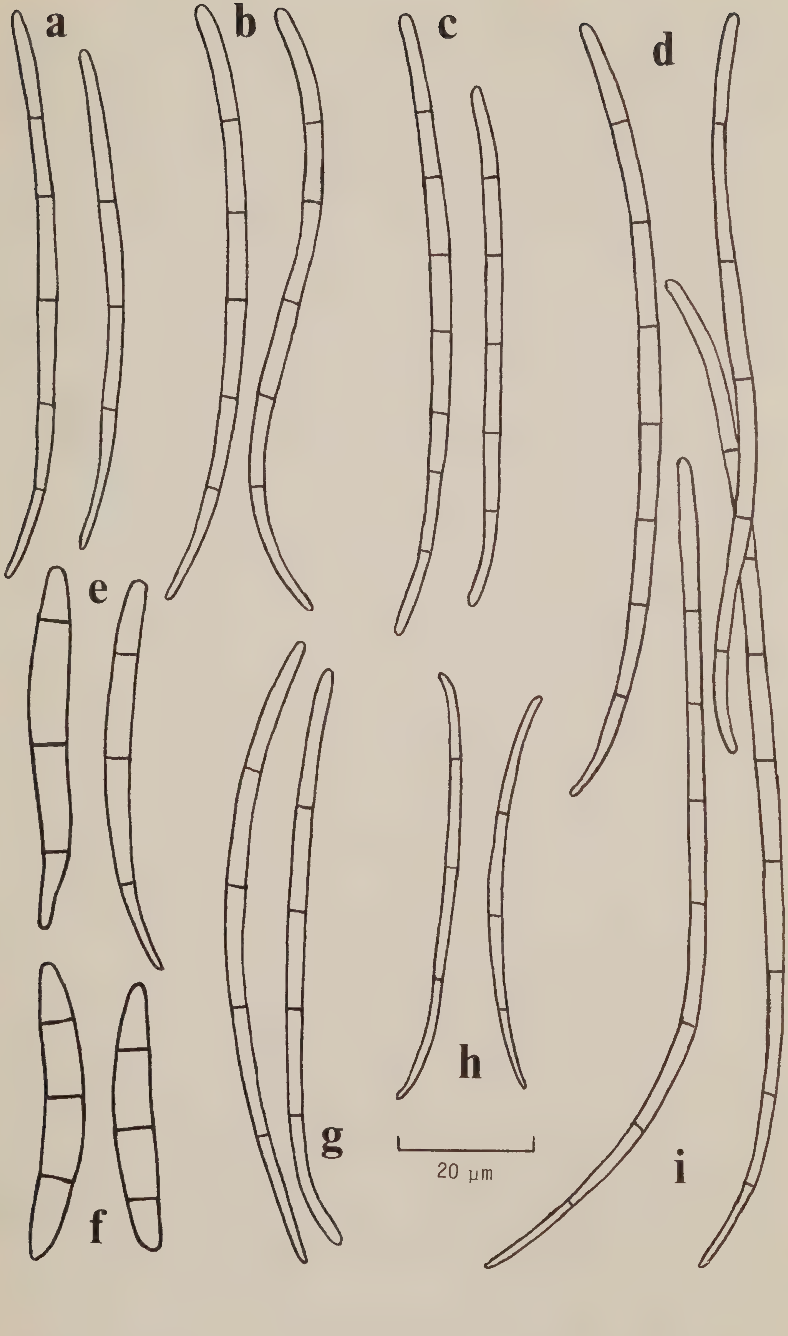
In describing their new genus, von Arx and Olivier (1952) did not examine the nomenclatural type, but based their description on specimens of the wheat take-all fungus, thought at the time to be Saccardo's fungus. Walker (1972) showed that they are distinct and established a new variety for the wheat take-all fungus (see below under *G. graminis* var. *tritici*). Examination of Saccardo's type and of many other collections of *G. graminis* and its varieties has shown that an important feature of *Gaeumannomyces* is production of a superficial mycelium on its hosts, with some hyphae forming strands and radiating fans, and others developing hyphopodia of various sorts. Hyphae and hyphopodia were not mentioned by von Arx and Olivier (1952) when describing *Gaeumannomyces*, so the generic description is amended here to include production of hyphopodia on a superficial mycelium as a generic character. The nature of the perithecial wall, of the paraphyses and of some spore characters is also clarified.

Gaeumannomyces von Arx et Olivier descr. emend.

Perithecia dispersa vel aggregata, corpus perithecii omnino immersum, globosum vel subglobosum vel late ellipticum, collo cylindrico subelongato vel elongato, erumpenti, medio vel obliquo, cum poro periphysibus punctiformi pertuso. Paries corporis cum strato externo textura epidermoidea (Figs. 3 and 4), ex pluribus stratis cellularum complanatarum compositis, olivaceus vel atro-brunneus, in sicco nigrescens. *Asci* numerosi, unitunicati, cylindrici vel elongati clavati, brevi stipitati, cum annulo refractivo in apice iodo non colorato, octosporis. *Ascosporae* (Fig. 8) in asco parallelae vel parum tortiles, filiformes vel anguste clavatae, plerumque parum arcuatae, primo continuae sed ad maturitatem septatae transversales plures, hyalinae vel dilutae ochraceae. Filamenta paraphyses simulans, septata , latissima basi, sensim decrescentia versus apices, ad maturitatem diffluentia. *Mycelium* superficiare ex hyphis brunneis septatis irregulariter ramosis laxe reticulatis compositum, hyphae parallelae plures plerumque in filis et interdum mycelium flabelliforme formantes, hyphae aliae cum *hyphopodiis* (Figs. 9 and 10) irregulariter dispositis, interdum vagina mycelialis fuliginea formantes hospiti insidens. Status conidialis (ubi cognitus) *Phialophora*.

Figure 8. *Gaeumannomyces* spp., pairs of ascospores. a. *G. graminis* var. *graminis*, from holotype in PAD (slide DAR 21032); b. *G. graminis* var. *graminis*, from lectotype of *Ophiobolus oryzinus* in PAD (slide DAR 21033); c. *G. graminis* var. *tritici*, from holotype, DAR 17916; d. *G. graminis* var. *avenae*, from neotype in K (slide DAR 32104); e. *G. cylindrosporus*, from holotype, IMI 192606 (dupl.DAR 31926); f. *G. cylindrosporus*, DAR 31925; g. *G.* tax. sp. 1 on Cyperaceae, DAR 32061; h. *G.* tax. sp. 3 on Cyperaceae, DAR 34174; i. *G. caricis*, from holotype in C (slide DAR 32062).


a
b
c
d
e
f
g
h
20 µm
i

Perithecia scattered or clustered, body completely immersed, globose, subglobose to broadly elliptical, with a cylindrical erumpent neck of variable length, placed centrally or obliquely on the body. Body wall in surface view a textura epidermoidea (Figs. 3 and 4), in section of several layers of flattened cells, olivaceous to dark brown, appearing black when dry. Asci numerous, unitunicate, cylindrical to elongated clavate, shortly stalked, with an apical refringent ring not coloured by iodine, eight-spored. Ascospores (Fig. 8) parallel or slightly curved, at first continuous but with several transverse septa at maturity, hyaline to faintly yellowish. Filaments resembling paraphyses between asci, septate, widest at the base and gradually narrowing towards the apex, dissolving at maturity. Superficial mycelium composed of brown septate irregularly branched hyphae forming a loose net-work, some parallel hyphae forming strands and sometimes radiating fans of mycelium, others with irregularly placed hyphopodia (Figs. 9 and 10), the mycelium sometimes forming a dark sheath on the host plant. Conidial state (where known) Phialophora.

All names in Gaeumannomyces are dealt with below. The accepted species are parasites on roots, crowns and lower stems and leaf sheaths of Gramineae and Cyperaceae. All produce superficial hyphopodiate mycelium, either on naturally infected stem and leaf sheath tissue and/or on inoculated cereal coleoptiles (Walker, 1980). Hyphopodia sometimes develop on roots and occasionally in agar culture (a discussion on the term 'hyphopodium' is given at the end of this paper). The aggregation of hyphae into strands, infection cushions (plate mycelium) and other organs of spread on, and infection of, the host is discussed in detail by several contributors to Asher and Shipton (1980). Ascospores in the known species are often tinted pale yellowish brown in mass and appear hyaline to faintly tinted singly. The tapering septate paraphysis-like filaments are readily seen in immature perithecia and have been figured for G. graminis var. graminis (as O. oryzinus) by Saccas and Fernier (1954) and for G. graminis var. tritici (as O. graminis) by Russell (1934) and Shoemaker (1974). In his study of perithecial development, Jones (1926) described and figured their formation by the 'mutual separation of vacuolated parenchyma to form the paraphysis-like filaments'. These so-called paraphyses in Gaeumannomyces thus represent the remains of the originally pseudoparenchymatous internal tissue of the perithecium, persisting as filamentous chains of cells during development of the asci, and later disintegrating (Jones, 1926).

Petrak (1952) reduced Gaeumannomyces to synonymy under Linocarpon H. & P. Sydow (1917). This is not in accord with the characters shown by the generic types. Gaeumannomyces produces a superficial mycelium with hyphopodia, non-stromatic perithecia are embedded in host tissue with an erumpent neck of variable length and position, and the known species are parasites of roots, crowns and lower stem and leaf sheaths of Gramineae and Cyperaceae. Linocarpon has no superficial mycelium, and perithecia are embedded in host tissue, covered by a dark clypeus and surrounded by variable development of stromatic tissue. The known species are saprophytes on plants in various families, especially Palmae. The type species of *Linocarpon*, *L. pandani*, and Petrak's (1952) *Linocarpon* names are dealt with under *Linocarpon*.

Holm (1948) considered the wheat take-all fungus as close to *Plagiosphaera* Petrak (1941). von Arx and Olivier (1952), in describing *Gaeumannomyces*, discussed *Plagiosphaera* and regarded it as distinct from, though closely related to, their new genus. Barr (1978) placed the two genera in different families of the Diaporthales and present work supports their separation (see below under *Plagiosphaera*).

Gaeumannomyces graminis (Sacc.) von Arx & Olivier var. *graminis*, *Trans.Brit.mycol.Soc.* **35** (1),29-33, 1952

- ≡ *Rhaphidophora graminis* Sacc., *Nuovo Giorn.bot.ital.* **7**, 307-308, 1875 (type in PAD !)
- ≡ *Ophiobolus graminis* (Sacc.) Sacc. in Roum.& Sacc., *Rev. mycol.* **3**, 45, 1881.
- ≡ *Ophiochaeta graminis* (Sacc.) K. Hara, *Byôchû-gai Zasshi* (*J.Plant Prot.*) Tokyo, **3**(5), 342-345, 1916 (original not seen : from Tanaka, 1917)
  - = *Ophiobolus oryzinus* Sacc., *Nuovo Giorn.bot.ital.*, N.S. **23** (1), 203, 1916 (type in PAD !)
    - ≡ *Linocarpon oryzinum* (Sacc.) Petrak, *Sydowia* **6**, 387, 1952.
    - ≡ *Gaeumannomyces oryzinus* (Sacc.) Schrantz (as '*oryzinum*'), *Bull.Soc.mycol.Fr.* **76**(4), 337, 1961 (illegitimate, Art.33, Stafleu *et al*, 1972)
    - = *Linospora pulchella* Speg.,*Anal.Mus.Nac.Hist. Nat. Buenos Aires* **23**, 71-72, 1912, illus. (type in LPS !)

This, the type variety of *G. graminis*, is a widespread, generally benign, parasite of several genera of Gramineae, although more pathogenic isolates are known (Walker,1972, 1973, 1975, 1980). Detailed descriptions, illustrations, hosts and geographic distribution are given in these references. It produces both simple and lobed hyphopodia (Fig.10) and has ascospores (70) 80-105 (110) x 2-3 (4) µm (Fig.8). Its use as a possible cross-protection agent against *G. graminis* var. *tritici* is discussed by Wong (1980).

Walker (1972) examined the types of *Rhaphidophora graminis* Sacc. and *Ophiobolus oryzinus* Sacc. and showed they were the same. *Linospora pulchella* Speg. also belongs here. In the type specimen, abundant perithecia are present in culm and leaf sheath tissue, associated with a superficial brown mycelium producing both pale simple and brown lobed hyphopodia. The unitunicate asci with an apical refractive ring contain ascospores typical of those of *G. graminis* var. *graminis*. From the description, *Ophioceras sorghi* Saccas (q.v.) may also be *G. graminis* var. *graminis*.

Details and comments are given below for several collections examined. Others are listed by Walker (1972). Unless otherwise mentioned, all collections showed perithecia, asci, ascospores and associated superficial mycelium with pale simple and brown lobed hyphopodia. Several of the specimens are the basis for earlier literature reports of this fungus under one or other of its synonyms and, where relevant, references to the literature are included after the specimen details.

Illustrations: See Walker (1980) where some illustrations are given, and references to many in the literature are included.

Specimens examined: on *Aristida* sp., Tamworth, N.S.W., Australia, 1976, P.T.W. Wong ADI, DAR 33669.

on *Avena sativa* L., Rydalmere, N.S.W., Australia, 23.xii.1969, A.M. Smith, DAR 19212; same, 25.ii.1970, DAR 19602; same, 26.xi.1970, DAR 20645 (all artificial inoculations with culture ex DAR 19211 on *Pennisetum*).

on *Axonopus compressus* (Schw.) Beauv. (turf, mainly this species), sports stadium, Hong Kong, no date, H.C. Tang, IMI 71816, as *Ophiobolus* sp. (slide as DAR 33292).

on *Axonopus* sp. (carpet grass), Gosford, N.S.W., Australia, 8.v.1970, J. Gellatley, DAR 19982 (hyphopodiate mycelium only).

on *Bromus unioloides* H.B.K., Rydalmere, N.S.W., Australia, 12.vii.1972, P.T.W. Wong Gl, DAR 23147 (see Wong, 1975); Walcha, N.S.W., Australia, 1977, P.T.W. Wong WAL9, DAR 33670.

on *Chloris gayana* Kunth., Grafton, N.S.W., Australia, 15.vi.1965, G. Wilson, DAR 14392 (hyphopodiate mycelium only).

on *Cynodon dactylon* (L.) Pers., Rydalmere, N.S.W., Australia, 17.i.1964, A.M. Smith, DAR 12417 (artificial inoculation with culture ex *Pennisetum*); Selva di Montella, N. of Treviso, Italy, 31.viii.1971, J. Walker, DAR 26005 (mycelium and lobed hyphopodia only).

on *Cynodon* or *Agropyron*, Selva, Treviso, Italy, Oct. (? 1874, P.A. Saccardo publ.1875), in PAD, HOLOTYPE of *Rhaphidophora graminis* Sacc. (slides as DAR 21032) (see Walker, 1972).

on *Glycine max* (L.) Merrill (as *G. soja*) isolated from pod, Indiana, U.S.A., 1974, K.W. Roy, culture producing abundant brown lobed hyphopodia, DAR 28746; same locality, colour slides of perithecia, asci and ascospores, ex K.W. Roy & D. Huber, DAR 30620. Unfortunately the perithecial material of this isolate was discarded and subsequent attempts to produce them with this culture have been unsuccessful (D. Huber, *in litt.*). Roy *et al* (1976) reported that the soybean isolates were highly pathogenic to wheat. One wonders whether the report of this fungus from soybean pods and leaves is the result of an adventitious infection from ascospores, which may have little significance as a disease of soybean.

on *Microlaena stipoides* R. Br., Newport, N.S.W., Australia, 1973, P.T.W. Wong G4, DAR 24168 (see Wong, 1975).

on *Molinia japonica* Hack., Gifu Prefecture, Japan, Feb. 1916, K. Hara, TNS - F210066 (slide as DAR 31879; formerly as *Ophiobolus graminis* Sacc. and *Linocarpon cariceti*; listed by Kobayashi (1970) as *L.cariceti*, specimen numbered in error as 210065).

on *Oryza sativa* L., all as *Ophiobolus oryzinus* Sacc. : Triangle, Rhodesia, 5.iii.1970, A Rothwell, IMI 147590; Peradeniya, Sri Lanka, 24.iii.1964, D.V.W. Abeygunawardena, IMI 104965; Lowland Farm, Shendam, Northern Nigeria, 3.xi.1959, Agricultural Officer, IMI 79545; Morogora area, Tanzania, July 1960, D.A. Burdekin, IMI 81744; Sembehun, Sierra Leone, Nov. 1940, F.C. Deighton, IMI 418; Mavea-Tebere, Kenya, July 1956, R.M. Nattrass, IMI 63390; Mount Maquiling, near Los Banos, Laguna Province, Philippine Islands, Oct. 1914, C.F. Baker, *F.malay.* 265, duplicates in BPI, DAOM, DAR 21861, K; Los Banos, Philippine Islands, Oct. 1914, C.F. Baker 3805, in PAD, LECTOTYPE of *O.oryzinus* Sacc. (Walker, 1972) (slides as DAR 21033); in rice crop, Calamba, Los Banos, Philippine Islands, 24.viii.1971, J. Walker, DAR 22145; from lodging plants in crop, Clare, North Queensland, Australia, 18.vii.1977, W. Pont, ex BRIP, DAR 29844; Ahuyna, Arkansas, U.S.A., 8.x.1928, E.G. Zieller, ex BPI as *Ophiobolus* sp. (slides as DAR 33689).

on *Paspalidium* sp., Walcha, N.S.W., Australia, 1976, P.T.W. Wong W2P, DAR 33671.

on *Pennisetum clandestinum* Hochst. ex Chiov., Tamworth, N.S.W., Australia, 28.iv.1964, A.M. Smith as *Ophiobolus* sp., DAR 12974; Grafton Experiment Farm, N.S.W., Australia, 28.iv.1964, A.M. Smith as *O. oryzinus* suspected, DAR 12981 (in both cases perithecia developed in the laboratory on field material originally showing only hyphopodiate mycelium); Bonshaw, N.S.W., Australia, 16.ii.1965, A.M.Smith, DAR 14006.

on *Phalaris* sp. (possibly), Entre Rios, Parana, Argentina, Sept. 1909, C. Spegazzini, LPS 2352, HOLOTYPE of *Linospora pulchella* Speg. (slide as DAR 25232) (Spegazzini, 1912).

on *Stipa aristiglumis* F. Muell., Warialda, N.S.W., Australia, Oct. 1973, P.T.W. Wong H4, DAR 25006.

on *Triticum aestivum* L., Rydalmere, N.S.W., Australia, 29.i.1974, P.T.W. Wong, DAR 24167 (Wong G5, see Wong, 1975) and DAR 25007 (artificial inoculations with culture ex DAR 25006 on *Stipa*).

on *Zizania aquatica* L., in greenhouse, Arlington, Virginia,U.S.A., 20.xi.1933, E.C. Tullis, as *Ophiobolus oryzinus*, ex BPI (slides as DAR 33691; abundant hyphopodiate mycelium and perithecia, asci and ascospores, some germinating in perithecia to give strongly curved phialospores).

Gaeumannomyces graminis var. *avenae* (E.M.Turner) Dennis, British Cup Fungi, 202, 1960
≡ *Ophiobolus graminis* var. *avenae* E.M.Turner, *Trans. Brit.mycol.Soc.* *24* (3-4), 279, 1940 (original collection lost, NEOTYPE in K !, see below).

This variety causes take-all of oats in Great Britain and other countries, and is widespread on many grasses, often causing severe disease in turf (Nilsson and Drew Smith, 1980). Detailed descriptions, illustrations, hosts and geographic distribution are given elsewhere (Turner, 1940; Walker, 1973, 1980). Within *G. graminis*, var. *avenae* is distinguished by its long ascospores, (85) 100-130 (140) x 2-3.5 (4) μm (Fig.8), and by producing simple hyphopodia only (Fig.10).

The isolates used by Turner (1940) were from Wales but later British workers found G. graminis var. avenae in England, Ireland and Scotland (Davies, 1950; Dennis, 1944; Garrett and Dennis 1943; specimens in K). In describing the new variety, Turner (1940) provided a latin diagnosis but did not specify a type collection. Her work was done at Rothamsted Experimental Station, and she mentioned in her paper that Miss E.M. Wakefield, Royal Botanic Gardens, Kew gave advice on the systematic status of the fungus. Enquiries made at both institutions failed to find her collections (J.M. Hirst, in litt.), they were not amongst the specimens of G. graminis var. avenae lent from Kew and none were located in IMI. In the absence of any of the original material and on the advice of Dr. R.W.G. Dennis, the collection from Applecross, West Ross, Scotland, 29.ix.1946, coll. R.W.G. Dennis is selected as NEOTYPE of G. graminis var. avenae.

Illustrations: See Walker (1980) where some illustrations are given, and references to many in the literature are included.

Specimens examined: unless otherwise stated, all specimens contained perithecia, asci and ascospores, and mycelium with simple hyphopodia. Other collections were listed by Walker (1972).

on Agrostis palustris Huds., Hartfield golf course, Perth, Western Australia, July 1972, G.C. MacNish, DAR 22111.

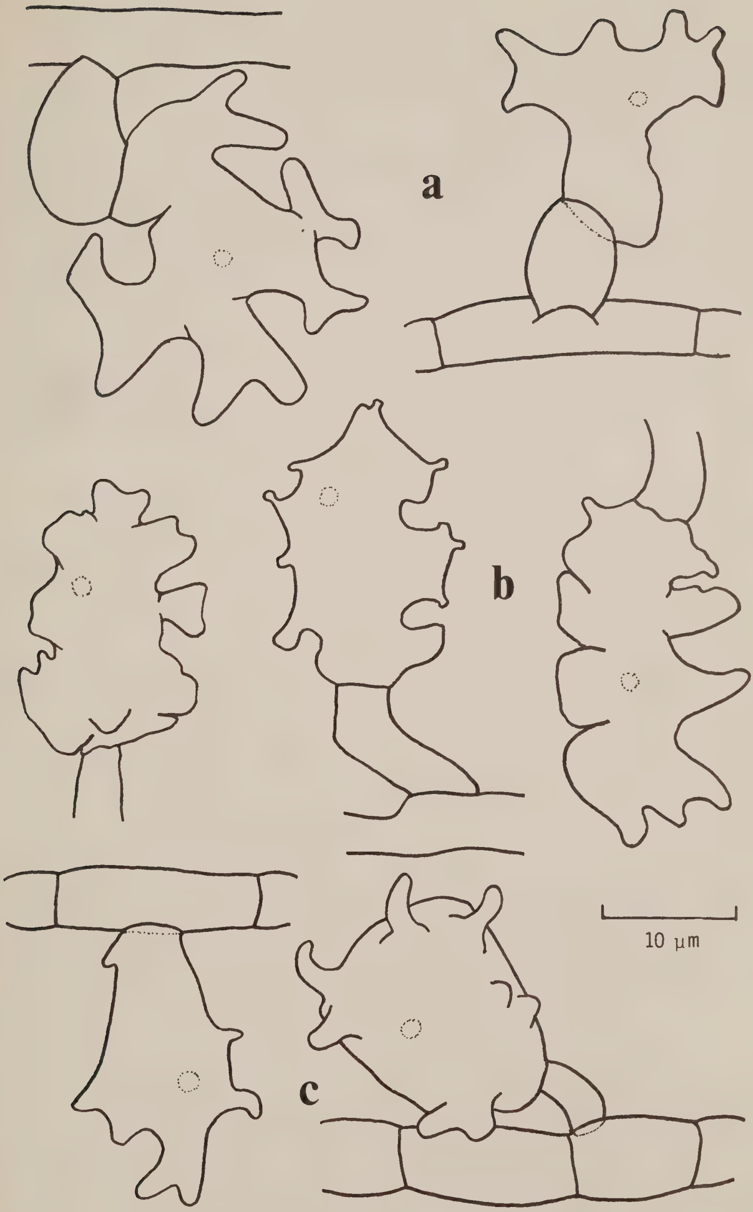
on Agrostis stolonifera L. (possibly), Victoria, Australia, 19.vi.1906, J. Harris, VPRI 276/06 (duplicates and slides filed as DAR 21034 and DAR 33272).

on Agrostis tenuis Sibth., golf course, Busselton, Western Australia, Oct. 1976, J. Yeates, DAR 31906; golf course, Bunbury, Western Australia, Oct. 1976, J. Yeates, DAR 31907; golf course, Denmark, Western Australia, July 1976, J. Yeates, DAR 31908; in lawn, Nedlands, Western Australia, Oct. 1976, J. Yeates, DAR 31909; Junee, N.S.W., Australia, 18.xi.1973, T. Siviour, DAR 25322.

on Agrostis sp., golf course, Bowral, N.S.W., Australia, April 1971, B. Stines, DAR 33697.

on Avena sativa L., Applecross, West Ross, Scotland, 29.ix.1946, R.W.G.Dennis,K,NEOTYPE of G. graminis var. avenae (slides as DAR 32104); Muckross Demesne, Killarney, Scotland, 29.viii.1946, R.W.G. Dennis, K (slides as DAR 32105); Braes of Ullapool, West Ross, Scotland, Aug. 1945, R.W.G. Dennis, K (slides as DAR 32106); Mumbles, Thornbury, Gloucestershire, England, 11.xi.1948, R.W.G. Dennis, K (slides as DAR 32101); Rademon, County Down, Northern Ireland, 16.iv.1948, R.W.G. Dennis, K (slides as DAR 32102); Wickepin, Western

Figure 9. Gaeumannomyces spp. on Cyperaceae, associated lobed hyphopodia. a. G. caricis, from holotype in C (slide DAR 32062); b. G. tax. sp. 1, DAR 32061; c. G. tax. sp. 3, DAR 34174.


a
b
c
10 µm

Australia, Nov. 1975, J. Yeates, DAR 31905; Warragul, Victoria, Australia, 9.xii.1910, J. Shugg, VPRI 958/10 (listed as first record for Victoria, as O. graminis; no perithecia seen, only mycelium, simple hyphopodia and infection cushions present; definite identification not possible); Rydalmere, N.S.W., Australia, 19.ix.1966, A.M. Smith, DAR 15857 (artificial inoculation with culture ex DAR 21022 on Agrostis sp.).

on Deschampsia bottnica (Wahl.) Hartm., Kulan, Lövånger parish, Västerbotten, Sweden, 10.ix.1945, L. Holm n.85, UPS (slides as DAR 33268; duplicate in DAOM, slide as DAR 33304; issued as Linocarpon cariceti (Berk. & Br.) Petr., F.Exs. Suecici No. 2172, Lundell and Nannfeldt, 1953; in both UPS and DAOM duplicates, asci still largely immature, but immature ascospores released under pressure commonly 110-115 µm long; very little superficial mycelium with a few simple hyphopodia present).

on Deschampsia danthonioides (Trin.) Munro ex Berth., near Kendrick, Idaho, U.S.A, 20.vii.1948, R. Sprague and Raeder, WSP 3976 (slides as DAR 33718; ascospores to 130 µm, abundant runner hyphae, simple hyphopodia and infection cushions (Walker, 1980) present. The number '16489' is also stamped on this packet).

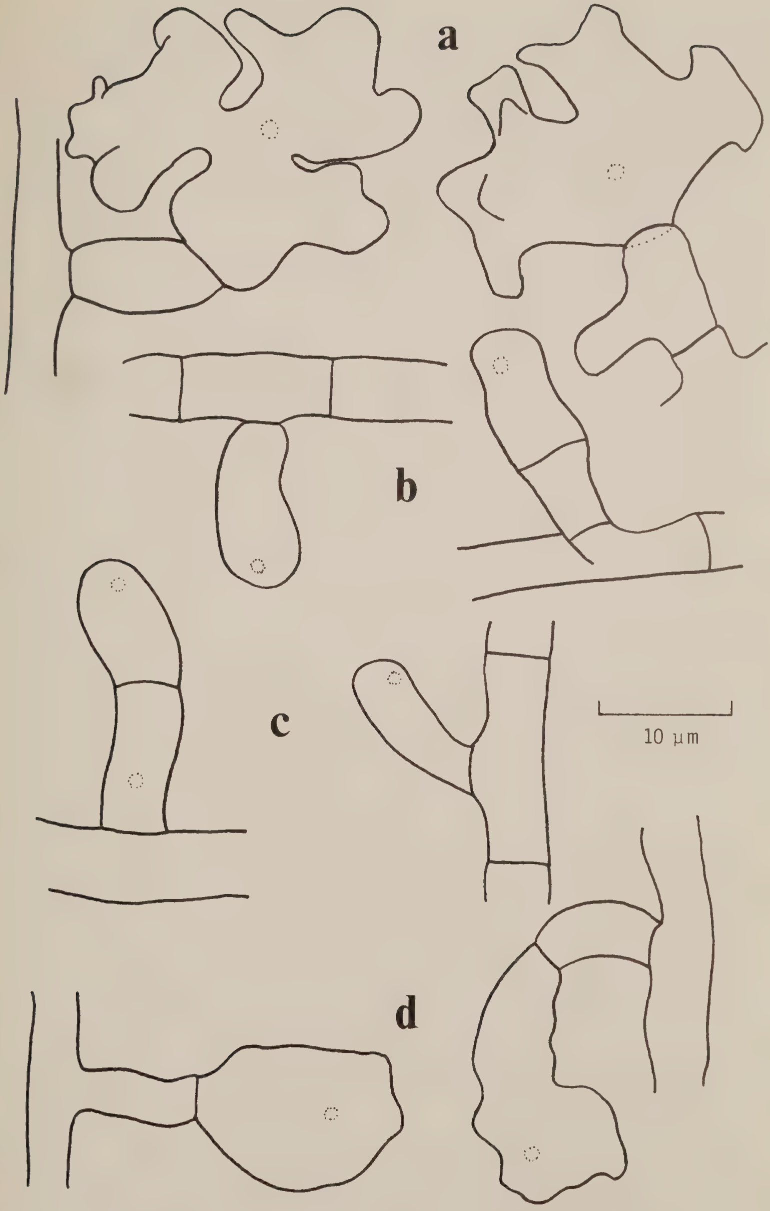
on Holcus sp., Applecross, West Ross, Scotland, 29.ix.1946, R.W. G. Dennis, K (slides as DAR 32103; growing in infected oat crop; asci and ascospores largely immature, ascospores released under pressure 102-115 µm long).

on Triticum aestivum L., Rydalmere, N.S.W., Australia, 19.ix.1966, A.M. Smith, DAR 25398 (artificial inoculation with culture ex DAR 21022 on Agrostis sp.).

Gaeumannomyces graminis var. tritici Walker, Trans. Brit. mycol. Soc. 58 (3): 439 (427-457), 1972.

The wheat take-all fungus has been fully described elsewhere (see descriptions, illustrations, references to literature, hosts and geographical distribution in Walker, 1972, 1973, 1975, 1980). It has a wide host range in the Gramineae and, under the name 'Ophiobolus graminis', has been the subject of intensive study for over 100 years (bibliographies given by Butler, 1961; Nilsson, 1969; Walker, 1975; Asher and Shipton, 1980). The name 'Ophiobolus graminis' properly applies to the fungus considered here as Gaeumannomyces graminis var. graminis but in most of the earlier literature it was used for the wheat take-all fungus G. graminis var. tritici (and sometimes also

Figure 10. Gaeumannomyces spp. on Gramineae, hyphopodia. a. G. graminis var. graminis, lobed hyphopodia, from holotype in PAD (slide DAR 21032); b. G. graminis var. tritici, from holotype, DAR 17916; c. G. graminis var. avenae, from neotype in K (slide DAR 32104); d. G. cylindrosporus, on wheat coleoptile from living culture DAR 25012.


a
b
c
10 µm
d

for the oat take-all fungus *G. graminis* var. *avenae*). In some articles, especially those dealing with grass hosts, it is not possible to know which variety of *G. graminis* was being referred to when the name *O. graminis* was used. Details of names misapplied to the wheat take-all fungus are given by Walker (1980). Within *G. graminis*, var. *tritici* is distinguished by ascospores (60) 70-105 (110) x 2.5-3 (4) µm (Fig. 8) and by producing simple hyphopodia only (Fig. 10). Walker (1980) discusses intravarietal variation within the three varieties of *G. graminis*.

Illustrations: See Walker (1980) where some illustrations are given, and references to many in the literature are included.

Specimens examined: a large number of collections have been seen and some were listed by Walker (1972). The list given here is a selection, containing specimens of some significance for the take-all literature, or for host and geographic ranges. Only specimens with perithecia, asci, ascospores and simple hyphopodia are listed. Some other specimens filed as '*Ophiobolus graminis*' in herbaria do not show perithecia, but mycelium, infection cushions and simple hyphopodia. These, and other collections where other fungi such as *Wojnowicia graminis* (McAlp.) Sacc. & D. Sacc., *Cochliobolus* spp. etc. were found, are dealt with in a separate section below.

on *Avena byzantina* C. Koch, Bathurst Experiment Farm, N.S.W. Australia, Nov. 1913, W.A. Birmingham, DAR 56 and 57 (asci 100-110 µm, ascospores shorter; slightly immature but more typical of var. *tritici* than var. *avenae*).

on *Avena fatua* L., Mukenbudin, Western Australia, Nov. 1975, J. Yeates, DAR 31904 (ascospores 70-106 x 2.5-4 µm).

on *Avena sativa* L., Coonalpyn, South Australia, Nov.1917, A.J. Spafford, ADW 391 as *O. graminis* (slide as DAR 33719; ascospores 85-100 (102) x 2.5-3 µm); Rydalmere, N.S.W., Australia, 6.v.1971, R. Bowditch, DAR 21027 (artificial inoculation with culture from DAR 17916 (type culture of var. *tritici*) on *Triticum*).

on *Bromus sterilis* L., Nuskerry East, Victoria, Australia, 21.xi.1903, T. Peters, VPRI as *O. graminis* (slides as DAR 33274); possibly portion of same, VPRI 65/04 (slide as DAR 33273).

on *Bromus vulgaris* (Hook.) Shear, foot of Hurricane Ridge Trail, Olympic National Park, Washington, U.S.A., 23.vii.1955, R. Sprague and P. Halisky, WSP 37470 as *O. graminis* (slide as DAR 33720; ascospores 80-100 (107) x 2.5-3 µm; see Sprague and Halisky, 1955).

on *Hordeum vulgare* L., Shizuoka Prefecture, Japan, 19.v.1914, T. Okada, TNS - F210068 as *O. graminis* (slide as DAR 31880).

on *Oryza sativa* L., Rydalmere, N.S.W., Australia, 6.v.1971, R. Bowditch, DAR 21025 (artificial inoculation with culture ex DAR 17916 on *Triticum*).

on *Triticum aestivum* L., Shizuoka Prefecture, Japan, 11.vii.1928, K. Hara, TNS - F210065 as *O. graminis* (slide as DAR 31878); same, Nov. 1925, K. Hara, TNS - F210099 as *Ophiochaeta graminis* (slide as DAR 31885; the host is given as *Oryza sativa* but the specimen is clearly wheat); Kenya, no date, H.C. Thorpe, IMI 121750 as *O. graminis*; Ferrara, Italy, 1896, Prof. Aducco, IMI 16858a as *O. graminis*

(Briosi & Cavara, I funghi parassiti delle piante coltivate od utili No. 306; pycnidia of Wojnowicia graminis (McAlp.) Sacc. & D. Sacc. also present, in external appearance very similar to Gaeumannomyces perithecia); duplicate of Briosi and Cavara F. paras. No. 306, BPI (slide as DAR 33694; no perithecia found); Raleigh, North Carolina, U.S.A., Dec.1923, F.A. Wolf, BPI as O. graminis, U.S.D.A. Path. Myc. Coll. 4465 (slide as DAR 33695); same, dup. in UPS; Geneva, New York, U.S.A., 5.vii.1921, R.J. Haskell and R.S. Kirby, BPI as Ophiobolus sp. (slide as DAR 33690; see Kirby, 1925); Italy, 1913, Cattino, PAD as O. graminis (slide as DAR 33721); many Australian collections on wheat in DAR.

Gaeumannomyces caricis sp.nov.

Perithecia in vaginis foliorum, corpus immersum fuscum vel nigrum, globosum vel subglobosum 300-400 µm diam, collum obliquum erumpens 150-180 µm longum, 80 µm latum, usque ad canalis cum periphysibus hyalinis ascendentibus vestitus; paries perithecii 30-40 µm crassus, ex 6-8 stratis cellularum complanatarum 8-10 x 2-5 µm constatus, strata interiora pallida brunnea, strata externa fusca textura angularis vel textura epidermoidea, ad hyphas brunneas septatas in cavitate vaginae foliae conjuncta. Asci (Fig. 6) unitunicati, elongati clavati, ad apicem rotundati cum annulo refractivo, basin versus attenuati, brevi (10-30 µm) stipitati, 140-180 x 10-14 µm, octospori. Ascosporae (Figs. 6 and 8) uniseriatae, parallelae vel parum tortiles, filiformes vel anguste clavatae cum apice rotundato, basin versus attenuatae, rectae vel plerumque arcuatae, hyalinae vel dilutae ochraceae (praecipue in massa), 7-8 septatae, (80) 120-150 (155) x 2-3 µm, contenta subtiliter granulata. Filamenta paraphyses simulans praesentia, non visa facile in peritheciis maturis. Mycelium superficiare in vaginis ex hyphis brunneis septatis irregulariter ramosis 3-6 µm latis laxe reticulatis compositis, cum hyphopodiis (Figs. 7 and 9) brunneis lobatis, plerumque profunde lobatis, variabilis, 18-27 x 15-20 µm vel usque ad 25 µm diam, cum puncto pellucido ad locum hospitis penetrati, lignitubera abundantes.

HOLOTYPUS: in vaginis foliorum Caricis paniculatae, Trelde Sande, Denmark, 5.vii.1937, Poul Larsen, in C

ISOTYPUS: Laminae vitreae, DAR 32062
Collectio altera: in Caricis acutiformis, Flatford Mill, Suffolk, England, 9.v.1948, E.A. Ellis, IMI 28589, cum nomine 'Ophiobolus eucryptus'.

Perithecia embedded in leaf sheaths, with dark brown to black globose to subglobose body 300-400 µm diam and erumpent eccentric neck 150-180 µm long and up to 80 µm wide, joined to brown, septate mycelium in the leaf sheath cavity. Perithecial wall 30-40 µm thick of 6-8 layers of laterally compressed cells, 8-10 x 2-5 µm, inner layers paler, outer layers dark brown and forming a tissue which in surface view is a textura angularis or tending to textura epidermoidea. Neck canal lined with hyaline upwardly-pointing periphyses. Asci (Fig. 6) elongated clavate, with a rounded apex and narrowing gradually to the base, 140-180 x 10-14 µm, unitunicate with a small but definite refractive apical ring 2 µm diam, containing eight ascospores, lower 10-30 (40) µm of ascus free of spores. Ascospores (Figs.6 and 8) uniseriate, lying straight or very slightly twisted in the ascus, faintly tinted yellowish in mass, hyaline to faintly tinted singly,

filiform with rounded apex and narrower rounded base, widest slightly above the middle, straight or more commonly slightly curved, sometimes more strongly curved towards the base, usually 7-8 septate, (80) 120-150 (155) x 2-3 µm, contents granular, often appearing finely banded under phase contrast. *Paraphyses* present, not readily seen in mature perithecia. *Superficial mycelium* on leaf sheaths of brown, branched, septate hyphae 3-6 µm wide bearing brown lobed hyphopodia on short side branches up to 10-20 µm long. *Hyphopodia* (Figs. 7 and 9) brown, lobed, often deeply lobed, very variable in shape and degree of lobing, 18-27 x 15-20 µm or up to 25 µm diam when isodiametric, with clear dot denoting place of host penetration. Abundant lignitubers in host tissue associated with infection hyphae.

G. caricis was referred to previously as *Gaeumannomyces* sp. by *Munk in* Larsen (1952) and by Munk (1953a) but later (Munk, 1953b) he accepted Petrak's (1952) conclusion that *Gaeumannomyces* should be in *Linocarpon* and redescribed and figured the fungus under the name *Linocarpon eucryptum* (Berk. & Br.) Petrak (Munk, 1957). Detailed reasons for rejecting the epithet '*eucryptum*' have been given previously (Walker, 1972) and generic differences between *Gaeumannomyces* and *Linocarpon* are described above and under *Linocarpon* (q.v.)

Pure culture work is needed to prove the connection between the perithecia of *G. caricis* and the closely associated hyphopodiate mycelium. Although known only from two collections at present, it is possibly more widespread (especially in Great Britain and Europe) and is described here to bring to the notice of mycologists and pathologists the presence of species of *Gaeumannomyces* on Cyperaceae. Other collections on Cyperaceae differing from *G. caricis* are mentioned below under '*Gaeumannomyces* spp. on Cyperaceae'. Walker (1980) has discussed the possible relationship between these fungi and graminicolous *Gaeumannomyces* spp. The need to avoid confusion with the hyphopodiate mycelium of *Clasterosporium* spp. on Cyperaceae has been pointed out elsewhere (Walker, 1972, 1980).

Gaeumannomyces cylindrosporus Hornby, Slope, Gutteridge & Sivanesan, *Trans. Brit. mycol. Soc.* ***69*** (1): 21-25, 1977 (type in IMI !)

Full descriptions and illustrations are given by Hornby *et al*. (1977) and Walker (1980). *G. cylindrosporus* is known only from a number of collections developed at Rothamsted on rotted cereal roots inoculated previously with isolates of *Phialophora graminicola* (Deacon) Walker (q.v.) which is probably its conidial state. Hornby *et al*. (1977) did not obtain germination of conidia produced in cultures derived from ascospores of *G. cylindrosporus*, but study of one of the original isolates they list (DAR 25011) has shown that they germinate (Fig.11). The strongly curved lunate to semicircular non-germinating phialospores seen in *G. graminis* have not been seen in this species. Although described originally as mostly cylindrical, most ascospores are fusoid, widest in the middle, narrower at

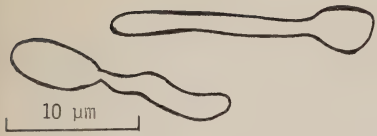


Figure 11. Gaeumannomyces cylindrosporus, germinating conidia, from culture DAR 25011.

the base than at the apex, and usually slightly curved. They are hyaline to faintly tinted yellowish in colour. Hyphopodia have been produced by cultures inoculated onto wheat coleoptiles (Hornby et al.,1977; Walker, 1980).

G. cylindrosporus is distinguished from G.graminis and its varieties by shorter, wider, fusoid ascospores (Fig. 8), (35) 40-70 (75) x 3-5 (6) μm with 3-5 (8) transverse septa, slightly lobed hyphopodia (Fig.10), production of only one type of phialospore, and much slower growth in culture (4-6 mm/24 hrs at 20-25°C compared to 6-12 mm/24 hrs for G. graminis varieties; see Table 1 under Phialophora). Conidia germinate (Fig. 11).

When borrowed originally, the type material lodged as IMI 192606 was found to be very sparse, consisting of only six or seven perithecia on two small fragments of root. In the one slide made from this material, abundant mature ascospores were seen, but no asci, and the perithecia seemed to be overmature. Dr. Hornby has now supplemented the IMI specimen with further material of the same collection and a duplicate has also been lodged as DAR 31926.

Specimens examined: All from roots of Triticum aestivum, inoculated with various isolates of Phialophora graminicola, Rothamsted, England; single ascospore isolate 99, 21.x.1974, D. Hornby, DAR 25011; single ascospore isolate 100, 21.x.1974, D. Hornby, DAR 25012; bulk ascospore isolate NA15, D. Hornby, DAR 25013; P. graminicola isolate 74/2/2-1, March 1975, D.B. Slope, IMI 192606, HOLOTYPE of G. cylindrosporus (slides as DAR 32148, dups. as DAR 25258 and DAR 31926); P.graminicola isolate 76/244-3, 4.vii.1976, D. Hornby, DAR 31925 (ascospores in this collection mainly 35-50 μm long, and practically all with only 3 septa. It does not seem to be immature as most asci have disappeared. In other collections showing longer spores with 5 or more septa, shorter 3-septate spores were seen in the same perithecium).

Gaeumannomyces leptosporus Iqbal, Trans.Brit. mycol.Soc.58 (2): 346-348, 1972 (type in K !).

This is not a Gaeumannomyces as defined here, and is transferred below to the genus Ophioceras Sacc.

Gaeumannomyces oryzinus (Sacc.) Schrantz (as 'oryzinum'), Bull. Soc. mycol. Fr. 76(4), 337, 1961.

This binomial was not validly published (Stafleu et al., 1972, Art.33) as publication details for the basionym Ophiobolus oryzinus Sacc. were not given. The accepted name is G. graminis (Sacc.) von Arx & Olivier var. graminis (q.v.).

Gaeumannomyces spp. on Cyperaceae

Under this heading are included collections on Carex producing Gaeumannomyces perithecia and an associated mycelium with both simple and lobed hyphopodia (Fig.9) and occasionally sclerotia, but with ascospores much smaller than those described above for G. caricis. Collections studied are few but fall into two overlapping groups on ascospore size. This may represent the limits of variation of one species or two closely related but distinct species. The two groups are referred to as taxonomic sp.1 and 3 (tax. sp. 2 (Walker, 1972) is G. caricis).

(i) Gaeumannomyces tax. sp. 1 (Walker,1972): characterised by ascospores (60) 70-100 (120) x 2-3 µm (Fig.8), this fungus is very similar to G. graminis var. graminis (Fig. 9). Whether it is the same, or a closely related species on a different host family requires further work (Walker,1980). One collection (IMI28563b) also has small dark brown to black, globose to subglobose sclerotia, 80-120 µm diam embedded in the spongy leaf sheath tissue in association with perithecia. Two other collections with sclerotia and hyphopodiate mycelium but no perithecia have been seen and may belong here.

(ii) Gaeumannomyces tax. sp. 3: characterised by ascospores (50) 55-75 (80) x 2-3 (4) µm (Fig.8). Two collections in K labelled 'Sphaeria eucrypta' described by Walker (1972) and one slide collection labelled 'Leptosphaeria paludosa Feltg.' in FH are placed here tentatively. Feltgen (1901) described L. paludosa from leaves of Carex vesicaria L. in Luxembourg. The slide in FH, which may have been prepared from the original collection, has become granular and cloudy, obscuring some details, but shows a fungus as follows:

> Perithecia with brown walls, 300-400 µm diam, short probably central neck to 120 µm long. Asci unitunicate, with an apical ring not readily distinguished, 95-115 x 9-11 µm. Ascospores eight, pale yellowish in mass, elongated fusiform, usually slightly curved, apex rounded, base thinner and narrowly rounded, (60) 65-75 (80) x 2.5 µm, with three distinct septa. Inter-ascal filaments resembling paraphyses, hyaline, septate with septa approximately 15 µm apart, 7-8 µm wide near base and tapering to the top. A small fragment of the host tissue bore a few brown, septate hyphae but no hyphopodia.

Saccardo and Saccardo (1905) transferred L. paludosa to Ophiobolus and listed the hosts as Carex vesicaria and Phalaris arundinacea L. Their description is similar to that given above, with perithecia 500-600 µm diam, asci 90-100 x 8-10 µm, and ascospores 60-75 x 3-4 µm with 7-10-12 septa. They also comment 'ad Ophiobolum graminis nutat'. L. paludosa could easily be a short-spored Gaeumannomyces on Cyperaceae but study of the type is needed to see if a hyphopodiate mycelium is present. The epithet 'paludosa Feltg.' may eventually provide a name in Gaeumannomyces for some of these short-spored collections.

The unsuitability of the epithet 'eucrypta Berk.& Br.'

for use in *Gaeumannomyces* has already been discussed (Walker, 1972). Collections in K under this name either have no host or locality information, or are on *Iris foetidissima* L.. Duplicates on *Iris* are present in L and PAD and the January 1859 collection on *Iris foetidissima* was issued as Rabenh. *Fung. Europ*. 49 under the name '*Sphaeria eucrypta* Berk. & Br.'. These *Iris* collections do not seem to be *Gaeumannomyces* and are dealt with under '*Plagiosphaera* sp.'.

Further collections, cultural studies to prove the connection between perithecia and the associated hyphopodiate mycelium, host range studies and comparisons with the graminicolous species are needed to elucidate the taxonomy and pathology of this little known group of *Gaeumannomyces* spp. on Cyperaceae.

Specimens examined: *Gaeumannomyces* tax. sp. 1 (see also collections on *Carex* sp., *C. acutiformis*, *C. pseudocyperus* L. and *C. riparia* listed in Walker, 1972); on *C. acutiformis*, Flatford Mill, Suffolk, England, 9.v.1948, J.P. Morgan, IMI 28563b (ascospores 90-115 (120) x 2.5-3 µm; found on specimen of *Acanthophiobolus helicosporus* in *Ophiosphaeria gracilis* folder, IMI 28563a); on *C. riparia*, Krotheimer Teich, Brünn, Germany, July, no year given, G. Niessl, in M (as '*Leptospora*' or '*Leptosphaeria*' with note 'sehr lange Sporen'; slides as DAR 33701). *Gaeumannomyces* tax. sp. 3; on host undet., probably Cyperaceae, no date or locality, labelled '*Sphaeria eucrypta*, C.E.B.' {C.E.Broome}, with M.C. Cooke's herbarium stamp, in K; on host undet., probably Cyperaceae, Batheaston, April 1859, labelled '*Sphaeria eucrypta* B.& B.', in K; on host undet., slide specimen A3785 Feltgen, labelled '*Ophiobolus eucryptus* (ubr. *Leptosph. paludosa* Feltg.)', in FH. Sclerotia and mycelium with lobed hyphopodia (but no *Gaeumannomyces* perithecia) seen in two collections: on *Carex elata*, Flatford Mill, Suffok, England, 9.v.1948, M.B. Ellis, IMI 28566b (found on specimen of *Acanthophiobolus helicosporus* in *Ophiosphaeria gracilis* folder, IMI 28566a); on *Carex* sp. aff. *C. bichenoviana* Boott, Armidale, N.S.W., Australia, 17.ix.1968, P. Duff, DAR 21030a.

Collections and records which cannot be placed accurately in any variety of *G. graminis*

Whilst there are many records in the literature of '*Ophiobolus graminis*' on a wide range of hosts, the exact identity of the fungus present is not clear in some cases. Several of the records on maize (*Zea mays* L.) (Petrak, 1952 as *Linocarpon cariceti*; Saccas, 1951) and sorghum and Johnson grass (*Sorghum* spp.) (Foëx and Rosella, 1934; Foëx, 1935; Saccas, 1954; Tarr, 1962) are of this kind. No specimens on *Zea* or *Sorghum* have been seen during the present work. The report by Tullis (1951) that *G. graminis* var. *graminis* (as *Ophiobolus oryzinus*) can overwinter on leaf sheaths of *Typha latifolia* L. has not been confirmed from specimens and a number of earlier grass host records in the literature are also uncertain.

In several herbaria, there are many specimens of root and crown diseases of cereals and grasses filed as '*Ophiobolus graminis*' and/or with the annotation 'take-all' or some similar term. Some do not show fruiting bodies, but have a brown superficial mycelium, with simple hyphopodia, and infection cushions, developed on lower portions of culms and leaf sheaths, and often abundant lignitubers in host cells. From notes filed with specimens, it is seen that collectors regarded the disease present as take-all and the fungus as '*Ophiobolus graminis*' and this was obviously correct in many cases. Now, however, such specimens do not show characters which allow their accurate placement in one of the varieties of *G. graminis*. In particular, it is not possible to distinguish var. *avenae* and var. *tritici* on material such as this. In other cases, often on old, weathered or last season's culms, perithecia typical of *Gaeumannomyces* are present, but no superficial mycelial structures are observed and a heavy growth of saprophytic moulds is often present. No definite determination can be made of such collections and var. *graminis* and var. *tritici* could not be distinguished on them. Finally there are those collections identified as *Ophiobolus graminis* (and often reported as such in the literature) on which no evidence of *Gaeumannomyces* could be found .

Some of these specimens are the basis for cereal and grass host records and geographic distributions published in the take-all literature (Nilsson, 1969 gives a comprehensive host list compiled from the literature; Nilsson and Drew Smith, 1980 discuss take-all on grasses). As an accurate knowledge of host ranges and distributions is important, a selection of some specimens which cannot be fully identified is given below, with brief notes on them. Unless otherwise stated, all were filed originally as '*Ophiobolus graminis*'and all showed only mycelium, with runner hyphae, simple hyphopodia and infection cushions (the presence of varieties of *G. graminis* on several of these hosts is known from other collections bearing perithecia).

on *Agropyron scabrum* (R.Br.) Beauv., Mordialloc, Victoria, Australia, 1.i.1904, C.F.J.M., VPRI 11/04, brown mycelium only, no evidence for *Gaeumannomyces*; *G. graminis* var *tritici* occurs on this host (Walker, 1972).

on *Bromus vulgaris* (Hook.) Shear, Stilaguanish River, Washington, U.S.A., 11.vi.1959, R. Sprague, WSP 46380 (slide as DAR 33722; *G. g.* var. *tritici* is known on this host e.g. WSP 37470).

on *Deschampsia danthonioides*, Mill Lake, Olympic National Park, Washington, U.S.A., 23.vii.1955, R. Sprague, WSP 37471 (slide as DAR 33723; Sprague and Halisky, 1955 as *Ophiobolus graminis*; *G.g.* var. *avenae* is known on this host (WSP 3976) and on other *Deschampsia* spp., see specimen list for *G. g.* var. *avenae*).

on *Festuca subulata* Trin., foot of Hurricane Ridge Trail,Olympic National Park, Washington, U.S.A., 23.vii.1955, R.Sprague and P.Halisky, WSP 37469 (Sprague and Halisky, 1955, as *O. graminis*; very little mycelium present, no hyphopodia found. *G. graminis* var. *tritici* was collected at the same time on *Bromus vulgaris*, WSP 37470.

on *Glyceria maxima* (as *Poa aquatica*), Malmedy, France, no date, Reliquiae Libertianae, Roum. Fung. Sel. Gallici Exsicc. 1591, DAOM (as Ophiobolus (Rhapidospora) graminis; slides as DAR 33299; perithecia, asci and ascospores similar to those of a Lejosphaerella sp. present, with pycnidia containing short cylindrical brown aseptate conidia; no Gaeumannomyces seen).

on Hordeum vulgare L., Tootoomi, Shizouka Prefecture, Japan, 1925, K. Hara, TNS - F210096 (as Ophiochaeta graminis) (slide as DAR 31883; brown runner hyphae, infection cushions and simple hyphopodia present, possibly either G. graminis var. tritici or var. avenae).

on Oryza sativa L., old stalks with saprophytes, Samaru, Zaria Province, Northern Nigeria, 26.vi.1961, E. Harris (618a and b), IMI 88650a (as O. graminis; perithecia with ascospores 70-100 µm, no hyphopodiate mycelium, probably G. graminis var. graminis, which is recorded from Northern Nigeria, see specimens listed and Harris et al., 1962 as O. oryzinus); Shizuoka City, Shizuoka Prefecture, Japan, Nov. 1925, K. Hara, TNS - F210098 (as Ophiochaeta graminis) (slide as DAR 31884; no sign of Gaeumannomyces seen, several fungi on leaf sheaths (a) Cochliobolus sp. (b) Pyrenochaeta oryzae Shirai ex Miyake (c) Sphaeropsidales undetermined (d) small sclerotia in leaf sheath tissue similar to those of Magnaporthe salvinii (Catt.) Krause & Webster; this collection was listed as Linocarpon cariceti by Kobayashi (1970).

on Panicum curtisii Chapm., Louisiana, U.S.A., no date or collector, ex Herb. Ellis 5021, PAD (as O. graminis; slides as DAR 33724; various fungi on leaf sheaths and stem; no evidence of Gaeumannomyces).

on Paspalidium geminatum (Forsk.) Stapf, Haifa Lake, West Pakistan, 10.xi.1966, S.R. Bagruar, IMI 134097a; perithecia with ascospore 70-100 µm long present; possibly G. graminis var. graminis but in the absence of hyphopodia cannot be distinguished from var. tritici.

on Pennisetum americanum (L.) K. Schum. (as P. typhoides), on old stalks from last year's plants, Samaru, Zaria Province, Northern Nigeria, 19.vii.1961, E. Harris, IMI 88659b (as Ophiobolus graminis); perithecia with ascospores 70-100 µm, no hyphopodiate mycelium, probably G. graminis var. graminis; Harris et al. (1962) reported var. graminis (as O. oryzinus) on seedlings of this host in Northern Nigeria and commented that it may survive on old millet stems.

on Phalaris aquatica L. (as P. tuberosa), south-eastern South Australia, Nov.1932, no collector given, ADW 1968; no perithecia, superficial mycelium or hyphopodia found, no evidence for presence of Gaeumannomyces.

on Phalaris minor Retz., Merredin Experiment Farm, Western Australia, Nov. 1932, no collector given, ADW 1967; very little mycelium, with a few infection cushions and simple hyphopodia, possibly a variety of G. graminis.

on Poa pratensis L., near Kendrick, Idaho, U.S.A., 20.vii.1948, R. Sprague and Raeder, WSP 3978 (slide as DAR 33725; no evidence of G. graminis was found. The lower leaf sheaths were discoloured and rotting, with several moulds and an amorphous black substance present. A note reads 'Apparently resistant as compared to other grasses in area'. G. graminis var. avenae was found at the same time on Deschampsia danthonioides, WSP 3976); start of Hurricane Ridge Trail, Olympic National Park, Washington, U.S.A., 23.vii.1955, R. Sprague, WSP 37472, (slide as DAR 33726; Sprague and Halisky, 1955 as O. graminis; small plants with stems brown near ground level and abundant algal cells forming a dark sheath at and just above the crown node. No evidence of G. graminis seen on this specimen. G. graminis var. tritici was found at the same time on Bromus vulgaris, WSP 37470); Clearwater River, Idaho, U.S.A., 1.viii.1948, R. Sprague and G. Fischer, WSP 3998 (slides as DAR 29776; no mycelium or other evidence for Gaeumannomyces found. Ascocarps of Phaeosphaeria herpotrichoides (de Not.) Holm in leaf sheaths and pycnidia of Dinemasporium graminum Lév. on sheaths).

on Trisetum cernuum Trin., Mill Lake, Olympic National Park, Washington, U.S.A., 23.vii.1955, R. Sprague, WSP 37474 (slide as DAR 33727; Sprague and Halisky, 1955 as O. graminis; runner hyphae, infection cushions, simple hyphopodia and lignitubers present, perhaps either G. graminis var. avenae or var. tritici).

on Triticum aestivum L., many wheat take-all specimens in herbaria do not show perithecia. This is to be expected as many specimens collected during the growing season are not at the stage where perithecia have developed. Some collectors developed perithecia on such specimens by alternate wetting and drying in the laboratory of crowns and attached culms and leaf sheaths soon after collection and material prepared in this way is very valuable for reference and authentication of the record at a later date. A selection from collections without perithecia is given with brief comments:

on Triticum aestivum, property of Mr. Skewes, Goolwa, South Australia, Nov. 1932, no collector given, ADW 1970 (abundant mycelial sheath, runner hyphae, infection cushions and simple hyphopodia, probably var. tritici); Bruce Rock, Western Australia, Jan. 1933, no collector given, ADW 1974 (abundant runner hyphae, infection cushions and simple hyphopodia, probably var. tritici); Lameroo, South Australia, 20.xi.1912, T.G.B. Osborne, ADW 390 (as Linocarpon cariceti in Hansford's writing; abundant mycelium with infection cushions and simple hyphopodia, probably var. tritici); Langhorne's Creek, South Australia, Oct. 1932, no collector given, ADW 1972 (specimen fragmentary, no evidence for Gaeumannomyces present); Horsham, Victoria, 3.x.1901, Mr. Smith, VPRI 1701 + 1 (as Ophiobolus herpotrichus Sacc.; slide as DAR 33275a; a little brown mycelium and a few very immature fruiting bodies in leaf sheaths, possibly Gaeumannomyces); Shizuoka Prefecture, Japan, 5.xii.1920, K. Hara, TNS - F210094 (as Ophiochaeta graminis; slide as DAR 31881; rectangular brown stem flecks containing brown clusters of fungal cells, a few empty fruiting bodies with outer wall layer a textura angularis present, no evidence for Gaeumannomyces); Suruga, Shizuoka Prefecture, Japan, June 1925, K. Hara, TNS - F210095 (as Ophiochaeta graminis; slides as DAR 31882; similar to TNS - F210094, no sign of Gaeumannomyces); Junction City, Oregon, U.S.A., 22.vi.1921, no collector given, WSP 4826 (slides as DAR 33728; abundant dark mycelial sheath, runner hyphae, infection cushions and simple hyphopodia, probably var. tritici); Vancouver Experiment Station, Washington, U.S.A., 26.vi.1959, R. Sprague, WSP 46801 (slide as DAR 33729; dark mycelial sheath, runner hyphae, infection cushions and simple hyphopodia present, probably var. tritici); Hungary, 1899, Linhart, PAD (as O. graminis; slide as DAR 33730; mycelium and simple hyphopodia, probably var. tritici).

on Vulpia bromoides (L.) Gray (as Festuca), Pinnaroo, South

Australia, 8.xi.1923, G. Samuel, ADW 388, (as *Linocarpon cariceti* in Hansford's writing), a little mycelium, a few infection cushions and simple hyphopodia, could be either var. *tritici* or var. *avenae*; var. *tritici* recorded on *Vulpia myuros* (L.) Gmel. in South Australia, ADW 389, see Walker, 1972.

on Gramineae undet., no locality, Herb. Libert 70, PAD (as *Ophiobolus graminis*; slides as DAR 33731; no perithecia or mycelium seen; pseudothecia of *Paraphaeosphaeria michotii* (Westend.) O. Erikss., *Mycosphaerella* sp. and *Pleospora* sp. seen; collection listed by Roumeguère and Saccardo (1881) as *O. graminis* and portion examined by Fitzpatrick *et al*., 1922, who also found no perithecia; see Walker, 1972); on grass culm, University of Pennsylvania, 2.iv.1911, no collectors name, PAD (as *O. graminis*; slides as DAR 33732; only pseudothecia of *Ophiosphaerella herpotricha* seen).

LASIOSPHAERIA

Lasiosphaeria gracilis Niessl = *Acanthophiobolus helicosporus* (q.v.).

'*Lasiosphaeria*' *helminthospora* Rehm - for discussion of this name, see under *Acanthophiobolus helicosporus*.

Lasiosphaeria raciborskii (Penz. & Sacc.) Carroll & Munk - see under *Ophiochaeta raciborskii*.

LEPTOSPHAERIA

Leptosphaeria Cesati & de Notaris, *Comment.Soc.Critt.Ital.* *1*, 234, 1863 (from Holm, 1957)
Type sp. *L. doliolum* (Pers.ex Fr.) Ces. & de Not. (for typification, see Holm, 1957).

Many species of *Leptosphaeria* are described in Müller (1950) and Holm (1957). The concept of the genus followed is that of Holm (1957) as set out in the keys of Luttrell (1973) and von Arx and Müller (1975). Some names encountered during current investigations are discussed here.

Leptosphaeria compressa (Rehm) Holm, *Symb.bot.Upsal.* **14** (3), 29-30, 1957
= *Exilispora plurisepta* Tehon & Daniels, *Mycologia* **19**, 113, 1927 (type in ILLS !)

Petrak (1941) considered *Exilispora* Tehon & Daniels (1927) as not distinct from *Ophiobolus*, but von Arx and Müller (1975) reduced it to synonymy with *Leptosphaeria*. Present work supports the latter view and indicates that the type (and only) species, *E. plurisepta*, is not distinct from *L. compressa*, as defined by Holm (1957). The type of *L. compressa* has not been examined, but a duplicate of one of the exsiccati listed by Holm (1957; Petrak *Myc.gen*.463) has been seen. The following description is based on the type of *E. plurisepta*:

Pseudothecia on dead stems, abundant, in lines between the vascular strands, at first covered by host tissue, later erumpent, seated in the stem on internal woody tissue, often two or more laterally compressed, subglobose to somewhat flattened, black, 200-400 µm diam, 200-300 µm high, with a short broad slightly protruding papillate neck, some ascocarps with a slightly thickened pressure ridge just below the neck (as described by Walker and Smith (1972) for L. narmari and L. korrae); wall 25-30 µm thick at sides, to 40-50 µm at base and near neck junction, of several layers of brown cells, 3-4 outer layers dark brown to black and almost opaque, 4-6 inner layers lighter in colour, cells oval to angular, 8-12 x 4-7 µm, in outer layers with much thickened walls, radially flattened especially in inner layers; ostiolar canal 20-25 µm diam, periphyses not seen. Asci (fig.2) numerous, arising from a basal hymenial layer, subcylindrical, apex rounded, widest in upper half and tapering gradually to the narrow, short base, bitunicate, 100-125 x 11-15 µm, several smaller immature asci also present, apical apparatus not seen (not studied), eight-spored. Ascospores (Figs.2 and 12) subcylindrical to elongated fusiform, ends obtuse, widest about 1/3 of length below apex, 75-100 (110) x 3.5-4.5 µm, tapering towards the base, lying parallel or slightly twisted in the ascus, 15-18 septate (counts in spores of different ages indicates that septation develops in the order 1,3,7,15, with secondary septa developing in some of the cells formed by these primary septa), constricted at the first formed septum (usually about 0.4 of length below apex and dividing the spore into a shorter apical and longer basal segment), usually less constricted at every second septum on either side of the first. Pseudoparaphyses abundant, hyaline, septate.

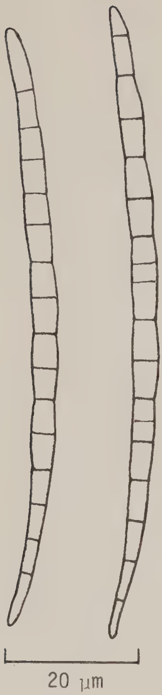


Figure 12. Leptosphaeria compressa, ascospores, from holotype of Exilispora plurisepta, ILLS 8404 (slide DAR 33733).

Illustrations: Holm (1957, ascospores); Shoemaker (1976, ascocarp wall, ascospores); Tehon and Daniels (1927, as Exilispora plurisepta, ascocarp, ascus with ascospores, pseudoparaphyses).

Specimens examined: on Erigeron sp., McNabb, Putnam County, Illinois, U.S.A., 28.vi.1922, C.L. Porter, ILLS 8404, HOLOTYPE of E. plurisepta (slides as DAR 33733); on Artemesia austriaca Jacq., Bisamberg, near Vienna, Austria, May 1940, F. Petrak Mycotheca generalis 463, IMI 30363 (as Ophiobolus compressus; slides as DAR 33734).

This description is very similar to that given by Holm (1957) for L. compressa. Shoemaker (1976, as O. compressus) described ascospores with slightly enlarged cells immediately on either side of the first-formed septum and his drawing (Fig.5) and photomicrograph (Fig.66) show this in spores from the specimen of Petrak's *Myc. gen.* 463 in DAOM. No definite cell enlargement was detected in the specimens examined here. Shoemaker (1976) did not mention the slight constriction at other septa, figured by Holm (1957) and suggested at one or two septa in his photomicrograph. This constriction at every second septum was clearly seen in the Petrak duplicate filed as IMI 30363. There is no tendency for spores to break at the first formed septum, as in the type species of *Ophiobolus*, *O. acuminatus*.

Leptosphaeria hesperia Barr (1967) - see discussion about *Ophiobolus rostrupii* under *Leptosporopsis*.

Leptosphaeria narmari Walker & Smith and *L. korrae* Walker & Smith, *Trans.Brit.mycol.Soc.***58**(3): 459-466, 1972

These Australian graminicolous species are described and illustrated by Walker and Smith (1972) and aspects of their biology discussed by various contributors to Asher and Shipton (1980).

Leptosphaeria paludosa Feltgen, *Vorstud.Pilz.Luxemb.*Nachtr. II, 157, 1901 (original not seen, from Saccardo & Sydow, 1902; type not seen).

For comments on this species on Cyperaceae, see under *Gaeumannomyces* sp. tax. sp.1.

Leptosphaeria tanaceti (Fckl.) Holm - the name accepted here for *Ophiobolus tanaceti* (Fckl.) Sacc.; see also under *Leptosporopsis*.

LEPTOSPHAERIOPSIS

Leptosphaeriopsis Berlese, *Icon.fung.***1**, 88, 1892
Type species *L. ophioboloides* (Sacc.) Berl. (based on *Leptosphaeria ophioboloides* Sacc.).

No specimens have been examined. From the descriptions and figures given by Berlese (1894, 1900), Holm (1957) and Shoemaker (1976), it appears to be a typical *Ophiobolus* Riess sens. str., and is considered here as *Ophiobolus ophioboloides* (Sacc.) Holm. *Leptosphaeriopsis* is listed as a synonym of *Ophiobolus* by Ainsworth (1971) and von Arx and Müller (1975).

LEPTOSPORA

Leptospora Rabenhorst, *Hedwigia* **1**, 116, 1857
Type sp. *L. rubella* (Pers.ex Fr.) Rabenh. (type not studied).

Leptospora is a monotypic genus and the single species, *L. rubella* has been described fully by several authors, either under that name or as *Ophiobolus rubellus* (Pers. ex Fr.) Sacc. (Müller, 1952; Holm, 1957; Dennis, 1968; Shoemaker, 1976). Müller (1952) and Holm (1957) list many synonyms. *L. rubella* occurs commonly on dead stems of many herbaceous plants and often produces a reddish-purple discolouration of invaded tissue. The genus is characterised by large, flask-shaped, often laterally compressed pseudothecia, usually with some attached superficial brown to reddish-brown hyphae and long cylindrical bitunicate asci with very thin (1-1.5 µm) filiform spirally arranged ascospores, and thin septate pseudoparaphyses.Most authors do not describe periphyses and Shoemaker (1976) stated that periphyses and apical hairs are absent. However, Müller (1952) figured periphysis-like structures and von Arx and Müller (1975), in their generic key, placed Leptospora in the section with no superficial hyphae and pseudothecia with an ostiolar pore lined with hyaline or brown periphysis-like bristles, often also with setae. Periphyses and setae were not seen in collections examined during the present work. No conidial states have been found for Leptospora and Luttrell (1973) used this in his generic key as one character to separate Leptospora from Cochliobolus (in which conidial states are known).

Whilst most collections of L. rubella listed in the literature are on dicotyledonous herbaceous plants, a number of collections on Gramineae have been seen which appear to belong in Leptospora. These and some other Leptospora names are listed below.

Leptospora rubella (Pers. ex Fr.) Rabenh., Herb.Myc.Ed.II
    n.532, 1857 (from Holm, 1957)
    = Ophiobolus trichisporus Ell. & Ev.,Proc.Acad.Nat.Sci. Phil. 1890, 239, 1890 (type in NY !)

Shoemaker (1976) examined portion of the type collection of O. trichisporus in DAOM and reduced the name to synonymy under L. rubella (as Ophiobolus rubellus). Portion of a collection in NY made at the same place on the same day has been examined by the present writer and a fungus agreeing with the original description of O.trichisporus was present. This supports Shoemaker's proposed synonymy. Whether the NY collection (from the Ellis herbarium) is portion of the type is not certain. It carries the number '1735' (no such number was quoted by Shoemaker) whereas the original description of O.trichisporus gives Dearness 1734 as the type collection. All other information agrees. Briefly, the NY collection is characterised as follows:

Pseudothecia dark brown to dark reddish-brown, flask-shaped to pyriform, 300-400 µm high, 200-300 µm wide with a short conical beak 70-100 µm long, 50-70 µm wide, seated in the culm tissue and erumpent through several layers of leaf sheath. Asci numerous, long cylindrical with a foot-like base, bitunicate, (135) 150-175 (180) x 4 µm,thickened to 2 µm at the apex (thickening to 6-7 µm in immature asci) which contains a net-like nassé. Ascospores spirally arranged in the ascus and probably longer than it, 1 (1.5) µm wide, indistinctly multiseptate, pale yellowish brown in mass, faintly tinted singly. Pseudoparaphyses hyaline, septate, 2-3 µm wide, longer than the asci.

Specimens examined: on Erechtites prenanthoides (A.Rich.) DC., Spruce Cove, Trinidad, California, U.S.A., Feb.1935, H.E.Parks 5312, dupl.ex

BPI 67246 as DAR 11328. On Gramineae undet., London, Ontario, Canada, 9.vi.1890, no collector's name given, n.1735, NY as *Ophiobolus trichisporus* Ell & Ev. (slides as DAR 34121).

Leptospora helminthospora Rehm - a synonym of *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (q.v.).

Leptospora implexa (Ell.& Ev.) Walker comb. nov.
≡ *Lophiostoma* (*Lophionema*) *implexum* Ell.& Ev., *J.Mycol.* 4 (8), 75, 1888 (type in NY !)
≡ *Ophiobolus implexus* (Ell.& Ev.) Ell. & Ev., North American Pyrenomycetes, 394, 1892.

Pseudothecia (Fig.13) on dead stem tissue and on clusters of dead adventitious roots at stem nodes, dark brown to black, with embedded globose body 300-450 μm diam and erumpent thick cylindrical to slightly tapering neck to 200-300 μm long, 200 μm diam near the base and only slightly narrower at the apex, sometimes slightly flattened, ostiolar canal circular in cross section 30-50 μm wide, inner wall a woven layer of hyaline hyphae 1.5-2 μm diam, some of which project up to 20 μm into the canal, no definite layer of periphyses seen. Wall of ascocarp to 50 μm thick at the base and sides, to 70 μm at junction with neck, with a very dense outer layer 14-18 μm thick in which cellular detail could not be distinguished and an inner layer to 30-35 μm thick of brown, thin-walled radially flattened cells 6-12 x 3-6 μm. *Asci* (Figs.13 and 19) long cylindrical to narrowly elongated clavate, tapered to a narrow base, bitunicate, apex rounded and only very slightly thickened, 120-160 x 7-10 μm. *Ascospores* (Figs.13 and 19) eight per ascus, long filiform and densely spirally coiled (6-7 turns in a 140 μm long ascus), longer than the asci, 1.5 μm wide, slightly narrower towards the base, faintly yellowish in mass, hyaline to faintly tinted singly, contents densely granular, closely and regularly beaded with small clear spherical vacuoles, some faint transverse septa seen in some spores but number and spacing (about 7-10 μm apart) difficult to determine. *Pseudoparaphyses* abundant, longer than the asci, hyaline, filiform, 1-1.5 μm wide, with several slightly swollen bumps along their length, indistinctly septate. *Superficial mycelium* joined to outer wall of pseudothecia, dense, of reddish-brown to dark brown branched septate hyphae 3-4 μm diam, no hyphopodia or conidiophores seen.

Specimens examined: on dead stem *Panicum maximum* Jacq., Sri Lanka, no collectors name given, letter of 15.iii.1927, IMI 16847 as *Ophioceras implexum* (? *Lophionema implexum*); on dead stem and adventitious roots of *Sorghum halepense* (L.) Pers., Point à la Hache, Louisiana, U.S.A., 30.vi.1886, A.B. Langlois 1439, *Flora Ludoviciana*, HOLOTYPE of *Lophiostoma* (*Lophionema*) *implexum* (slides as DAR 33682), in NY.

In the original description, Ellis and Everhart (1888) listed this fungus on dead adventitious roots of *Sorghum halepense* and on the lower part of sheathing leaves of a possible *Andropogon* sp.. However, they cite only one collection (Langlois 1439) and it is this collection, on *S. halepense* in the Ellis collection in NY, that is the holotype. The fungus on IMI 16847 from Sri Lanka has asci to 180 μm long but otherwise agrees exactly with the type. Whilst the necks on some pseudothecia are somewhat flattened laterally, most are circular in section and the

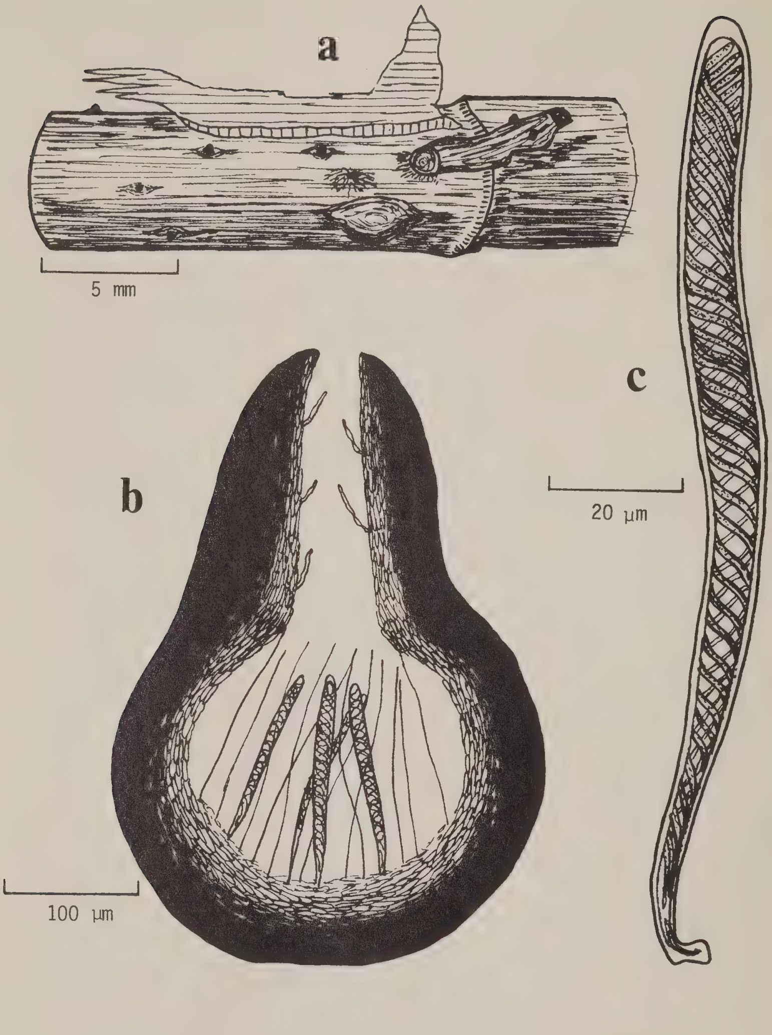

a
5 mm
b
100 µm
c
20 µm

Figure 13. Leptospora implexa, from holotype in NY (slide DAR 33682). a. habit; b. section ascocarp; c. ascus with spiralled ascospores.

ostiolar canal is circular in all cases. *L. implexa* is not related to *Lophiostoma* or other genera of Lophiostomataceae (Chesters and Bell, 1970).

Other possible species of *Leptospora*

From their original descriptions, *Ophiobolus leptosporus* Saccas, *O.spirosporus* Ahmad and *O.tortilis* Sydow could be better placed in *Leptospora*. However, until type specimens can be examined, their exact identity remains uncertain. See under the *Ophiobolus* names for comments.

LEPTOSPOROPSIS

Leptosporopsis Höhnel, *Akad.Wiss.Wien Sitzungsber.,Math.-Naturwiss.Kl., Abt.1*, **129**(3), 174, 1920.

Höhnel (1920) proposed this name for certain fungi related to *Leptosphaeria* with dothideaceous ascocarps and scolecospores. He did not nominate a type species and made no new combinations in *Leptosporopsis* but in the discussion suggested that *Ophiobolus compressus* Rehm, *O.tanaceti* (Fckl.) Sacc., *O.herpotrichus* (Fr.) Sacc. and *O.rostrupii* Ferd. & Winge should be placed in it. Petrak (1924) disagreed strongly with Höhnel's conclusions, considered that there was no basis for erection of the new genus and that '*Leptosporopsis* von *Leptospora* Rabh. absolut nicht verschieden'. Clements and Shear (1931) listed *Leptosporopsis* as a synonym of *Ophiobolus*, and its type species as '*L.rostrupi* (F. & W.) Hoehn.' (there is no evidence that Höhnel made this combination). Ainsworth (1971) quoted Clements and Shear and listed it as a synonym of *Ophiobolus*. It was not considered in the von Arx and Müller (1975) treatment of bitunicate Ascomycetes.

Leptosporopsis Höhnel (1920) is a *nomen nudum*, and not validly published (Art.41). The species suggested for it by Höhnel (1920) are disposed as follows:

Ophiobolus compressus Rehm - following Holm (1957), this is considered to be a long-spored *Leptosphaeria*, *L. compressa* (Rehm) Holm (q.v.). It is not an *Ophiobolus* Riess sens. str., where it is placed by some workers (Müller, 1952; Shoemaker, 1976).

Ophiobolus herpotrichus (Fr.) Sacc. - placed here as *Ophiosphaerella herpotricha* (Fr.) Walker (q.v.). A microscope slide labelled '*Leptosporopsis herpotrichus*' was seen amongst the v. Höhnel collections in FH; see specimen list under *Ophiosphaerella herpotricha*.

Ophiobolus rostrupii Ferd. & Winge - a later name for the fungus considered here as *Ophiobolus prunellae* (Ell. & Ev.) Shoemaker (1976) based on *Linospora prunellae* Ell. & Ev. (as '*brunellae*'). Four slides from FH marked 'A.F.Columb. *Leptosporopsis brunellae*' (one numbered '3786'), possibly made by Höhnel (1920), have been examined and show a fungus with the following characters:

Ascocarps broken, size not determinable. *Ascocarp wall* 20-35 µm thick, of 4-5 layers of brown slightly flattened cells 7-12 (14) x 4-6 µm, cell wall in outer layers thickened to 2-2.5 µm, thinner and paler in inner layers. *Ostiole* central. *Asci* 100-125 x 12-13 µm (to 150-175 µm long in one slide), bitunicate, much thickened at tip which has a thin central canal, eight-spored. *Ascospores* filiform, pale yellowish in mass and singly, 112-125 (130) x 3-4 µm, 7 septate, constricted at the central septum and cell on either side slightly swollen, widest in the middle and tapering gradually to the rounded apex and more sharply to the thin base, tending to break at the central septum into two half spores. *Pseudoparaphyses* abundant, hyaline, filiform, septate, 1-1.5 µm wide.

With ascospores having slightly swollen cells on either side of the central septum, at which some separation into half spores is occurring, this seems to fit better into *Ophiobolus* than into *Leptosphaeria* where it was placed by Barr (1967), as *L.hesperia* Barr. The name *Leptosporopsis rostrupi* (F. & W.) Hoehn. in Clements and Shear (1931) refers to this species.

Ophiobolus tanaceti (Fckl.) Sacc. - placed by Holm (1957) as *Leptosphaeria tanaceti* (Fckl.) Holm. This is accepted here.

LIDOPHIA

Lidophia Walker & Sutton, *Trans.Brit.mycol.Soc.***62** (2),232 1974

≡ *Dilophia* Sacc., *Syll.Fung.***2**, 357, 1883, non *Dilophia* Thompson, *Hooker's J.Bot.***5**, 19, 1853 (Cruciferae)

Type species: *L. graminis* (Sacc.) Walker & Sutton (type in G !)

The new name *Lidophia* Walker & Sutton (1974) was proposed for the invalid later homonym *Dilophia* Sacc.(1883) and a full description of pseudothecia, asci and ascospores given. von Arx and Müller (1975), in their study of bitunicate Ascomycetes, commented that the Walker and Sutton description was inadequate but that the genus was close to, and probably not different from, *Leptosphaeria*. In collections they studied, the fungus could not be found or was insufficiently developed.

Walker and Sutton (1974) found *L.graminis* only in the type specimen, in close association with pycnidia of *Dilophospora alopecuri* (Fr.) Fr.. Pseudothecia were embedded in the slightly swollen leaf and shoot tissue of the grass host amongst the pycnidia, in a stroma composed of host and fungal tissue, whose outer layer formed a clypeus penetrated by pseudothecial and pycnidial ostioles. The bitunicate asci (100) 110-130 (135) x 7-9 µm contained eight, pale yellowish, narrowly fusiform ascospores, 60-100 x (1.5) 2 (2.5) µm, widest in the middle, tapering gradually into an elongated fine thread at each end, with about 15 septa, and slightly constricted at the central septum, where they break at maturity into two equal part spores. Hyaline pseudoparaphyses were present between the asci and longer than them. Pseudothecia were not found on leaf spots with

Dilophospora pycnidia, where stromatic development was much reduced.

These characters indicate that Lidophia is a Pleosporaceous genus, resembling Ophiobolus Riess in having spores breaking readily into half spores at the central septum, but with no swollen cells as in Ophiobolus. Several earlier authors have described and figured this ascomycete with narrowly fusiform spores associated with Dilophospora alopecuri (see details in Walker and Sutton, 1974), although it is rarely found. It may be the perfect state of Dilophospora but this remains to be proved. In contrast to the opinion of von Arx and Müller (1975), Lidophia is regarded as a distinct, if rare, genus of Pleosporaceae, close to, but distinct from, Ophiobolus Riess. With its thin (2 µm) pale yellowish elongated fusiform spores, breaking at the central septum, it seems quite distinct from Leptosphaeria as delimited by Holm (1957), Luttrell (1973) and von Arx and Müller (1975). The significance and constancy of stromatic development in Lidophia can only be determined from further collections. With the associated Dilophospora pycnidia, stroma development is variable and may be absent (Walker and Sutton, 1974). Further collections should perhaps be sought on grass shoots heavily infected with Dilophospora, where well-developed stromatic tissue is present. Specimens examined were listed by Walker and Sutton (1974).

LINOCARPON

Linocarpon H. & P. Sydow, Ann.Mycol.15, 210, 1917
Type sp. L. pandani (H.& P.Syd.) H. & P. Syd.

The genus was erected for a fungus found on dead Pandanus leaves in the Philippines. Several species have been described since, and Petrak (1952) transferred to Linocarpon a number of species formally placed in Ophiobolus and reduced Gaeumannomyces von Arx & Olivier to synonymy. Petrak's concept of Linocarpon includes several species with characters not in keeping with those shown by the type species. This is described, and various Linocarpon names are listed and their relationships discussed.

Linocarpon pandani (H. & P. Syd.) H. & P.Syd.,Ann. Mycol.15, 210, 1917
≡ Linospora pandani H.& P. Syd., Ann.Mycol.11,60,1913, (basionym, type in S !)
= Linospora pandani Rehm, Leaflets of Philippine Botany 8, 2954, 1916 (later homonym; duplicates of Rehm specimens in DAR !)

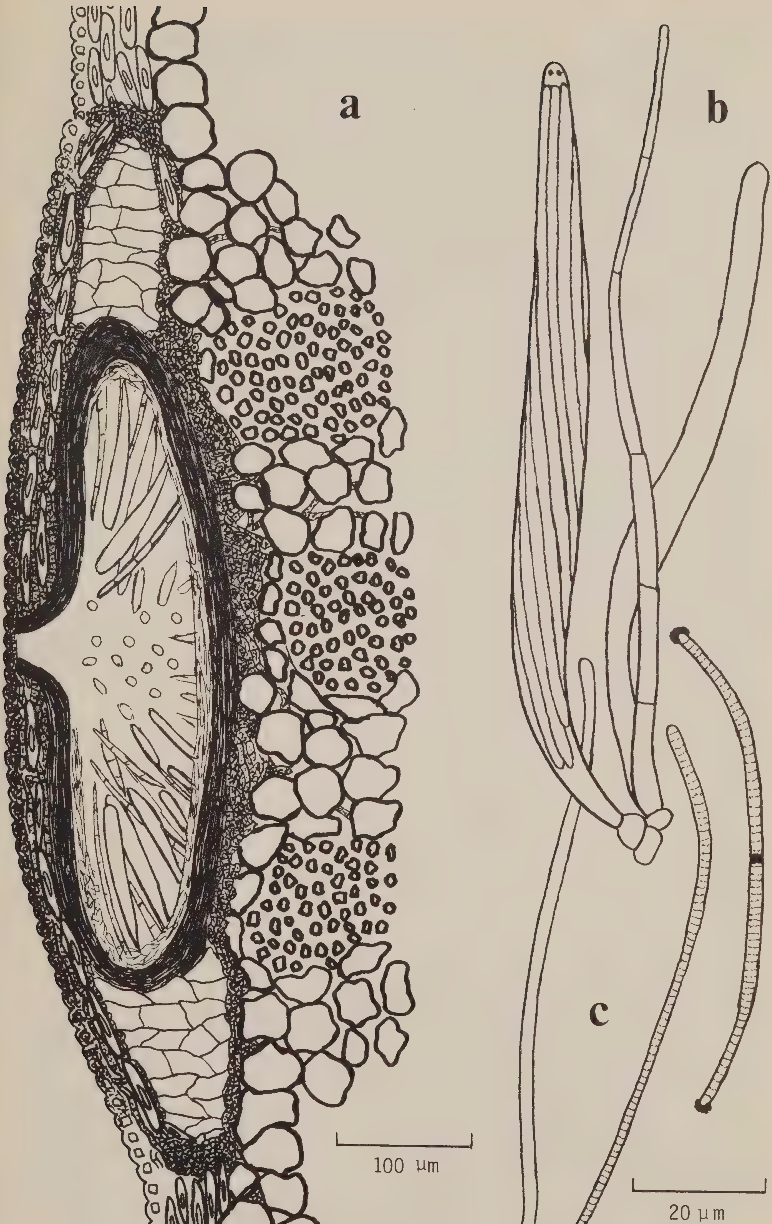
Fruiting bodies on host leaves as black, often shiny, slightly raised circular spots up to 1 mm diam, with a small central ostiolar dot; in section, lenticular, developing amongst leaf cortical cells beneath the host epidermis and above a layer of host fibre bundles (bundles to 100 µm diam, and 75-100 µm apart), composed of a lenticular perithecium (Fig.14), with overlaying clypeus and variable development of stromatic tissue laterally. Clypeus to 1 mm diam, composed of epidermal cells packed with fungal hyphae and beneath this a layer of radially arranged dark brown septate hyphae 2.5-3 µm wide (Figs. 15 and 16); *stromatic tissue* surrounding perithecium, in young fruiting bodies composed of pale brown irregularly shaped cells 5-10 x 3-4 µm, later interspersed with vertical bands of dark brown hyphae, mixed with host tissue and bounded at sides and below by a dark layer 15-20 µm thick of compressed hyphae (Figs. 14,17 and 18). *Perithecia* one per stroma, lenticular, to 600-650 µm diam and 200-300 µm thick when mature, several 150 x 40-50 µm and immature, with dark brown to black wall 15-25 µm thick at sides, of 4-6 layers of radially flattened dark brown cells, fusing with the clypeus above and with the stromatic tissue and invaded discoloured layers of host cells below, ostiole central 20-30 µm diam, piercing the clypeus, periphyses not seen. *Asci* (Fig. 14) in a basal layer, long cylindrical, with a tapering base, 100-130 x 5-8 µm, unitunicate, apex rounded, thickened to 2 µm, with small apical ring, eight-spored. *Ascospores* (Fig.14) filiform, pale yellowish in mass, hyaline to faintly tinted singly, (65) 70-100 x 1.5-2 µm, very slightly wider centrally, ends rounded, parallel or slightly spiralled, containing numerous refringent septum-like bands 2 µm apart, with a small, inconspicuous gelatinous appendage at one or both ends. *Paraphyses* (Fig.14) seen only in immature perithecia, hyaline, 3-4 µm wide at base, tapering to apex, longer than asci, sparingly septate. *Hyphae* in host tissue, hyaline to pale brown, branched, septate, 1.5-2.5 µm diam, no superficial mycelium developed.

Illustrations: Schrantz (1961, section ascocarp, ascus tip structure, ascospores).

Specimens examined: on *Pandanus laevis* Lour., Davao, Mindanao, Philippine Islands, March 1904, E.B. Copeland 592,S, HOLOTYPE of *Linospora pandani* Syd. (slides as DAR 31927); on *Pandanus sabotan* Blanco, Mount Maquiling, Los Banos, Philippines, April 1914, C.F. Baker *Fungi Malayana* 152a (as *Linospora pandani* Rehm), DAR 25194; on *Pandanus utilissimus* Elm., Mt. Banahao, Philippine Islands, Dec.1913, C.F. Baker 2247, S, (slides as DAR 31928); same, C.F. Baker *Fungi Malayana* 545, DAR 31929; same, C.F. Baker *Fungi Malayana* 152 (as *Linospora pandani* Rehm), DAR 25193.

H. & P. Sydow (1917) erected their new genus *Linocarpon* for the previously described *Linospora pandani* H.& P.Sydow (1913), listed in synonymy. The specimen on *Pandanus laevis* (E.B. Copeland 592) cited in their 1913 paper is the type of *Linospora pandani* and thus of the genus *Linocarpon*; the collection cited in their 1917 paper, on *P. utilissimus* (C.F. Baker 2247), is merely another collection. Rehm (1916) independently described this species as *Linospora pandani* Rehm from Philippine collections but his name is a later homonym of *L. pandani* H. & P. Sydow.

Figure 14. *Linocarpon pandani*, from type in S (slide DAR 31927), a. section ascocarp showing some marginal stromatic tissue and epidermal clypeus; b. young asci and paraphysis; c. ascospores (two on right from DAR 31928)


a
b
c
100 µm
20 µm

Stromatic development varies between collections. In all, a definite clypeus is always present but, in the holotype, there is also marked stromatic development around the perithecium. This is not so marked in Baker 2247. The fungus develops amongst the large thin-walled cells of the leaf cortex and, as it enlarges, flattens host cells above and below it. The firm layer of fibre bundles beneath the cortex (Fig.14) prevents development in that direction and growth occurs radially into the cortex as a wedge of stromatic tissue (Figs.14,17 and 18). The overlaying tissues are slightly raised, the black clypeus develops in and below the epidermis and the fungus is seen as shallow shield-shaped circular black dots on the leaf. Petrak and Deighton (1952) and Pirozynski (1972) have commented on the influence of host anatomy on perithecium shape in the closely related (perhaps identical) *L.elaeidis* Petrak apud Petrak & Deighton on oil palm.

With its clypeate, stromatic, embedded, centrally ostiolate perithecia, no superficial hyphopodiate mycelium and saprophytic habit, *Linocarpon* is quite distinct from *Gaeumannomyces*.

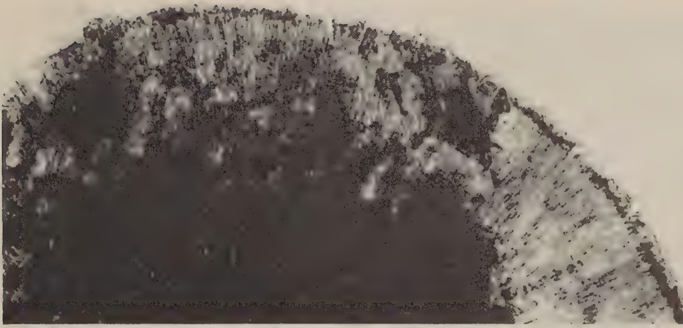
Other *Linocarpon* names

L.cajani Deighton apud Petrak & Deighton (1952), on *Cajanus cajan* (L.) Huth, Newton, Sierra Leone, 16.xi.1950, F.C. Deighton, IMI 46618, HOLOTYPE ! This is a good *Linocarpon* and is described and illustrated by Pirozynski (1972) from the type and from a collection he places here on dead, decaying rachides of oil palm (*Elaeis guineensis* Jacq.) from Tanzania.

L.cariceti (Berk.& Br.) Petrak (1952), basionym *Sphaeria cariceti* Berk.& Br. (1861). Petrak (1952) used this name for the cereal take-all fungi and reduced *Gaeumannomyces* von Arx & Olivier (1952) to synonymy under *Linocarpon*. These two genera are quite distinct (see above and descriptions of the type species given in this paper). The unsuitability of the epithet '*cariceti* Berk.& Br.' for current use and its typification have been dealt with elsewhere (Walker, 1972).

L.elaeidis Petrak apud Petrak & Deighton (1952), on *Elaeis guineensis*, Newton, Sierra Leone, 16.xi.1950, F.C.Deighton, IMI 46620a, HOLOTYPE ! This seems hardly distinct from the generic type, *L.pandani*. However, until further work is carried out on a range of palm fungi with names in *Linocarpon*, *Ophiobolus* and other genera, it is kept separate. It is fully described and illustrated by Pirozynski (1972).

Figures 15-18. *Linocarpon pandani* from type in S (slide DAR 31927). 15. Radial hyphae in clypeus, x 183. 16. Detail of radial structure, x 733. 17. Margin of ascocarp showing wedge pushing into host tissue, and epidermal clypeus, x 183. 18. Detail of marginal wedge, x 733.



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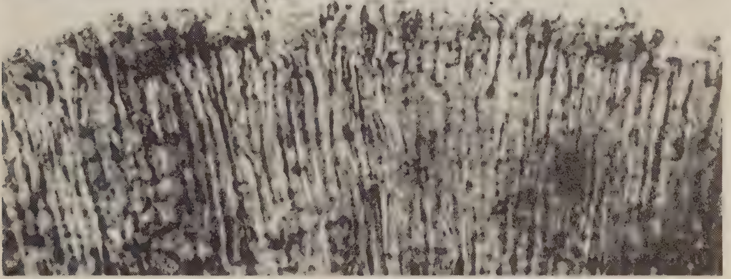

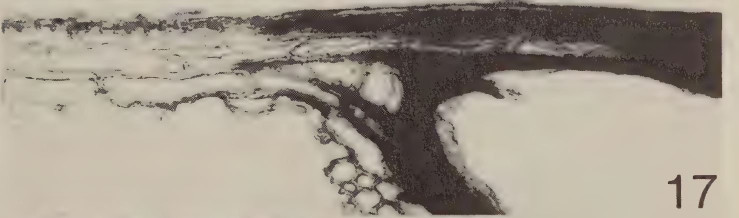

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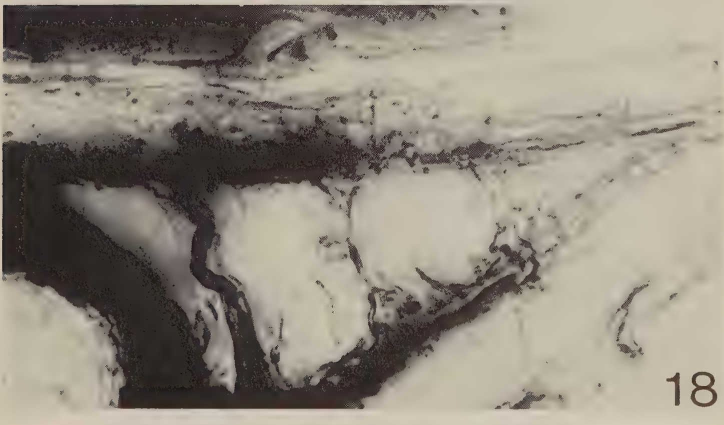

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L. eucryptum (Berk. & Br.) Petrak - see under *Sphaeria eucrypta* Berk. & Br.; not a *Linocarpon*.

L. halimum (Diehl & Mounce) Petrak (1952) - now placed as *Lulworthia halima* (Diehl & Mounce) Cribb & Cribb (1955); originally as *Ophiobolus halimus* Diehl & Mounce (q.v.).

L. livistonae (P.Henn.) Schrantz (1961) - combination not validly published (Art.33); see under *Ophiobolus livistonae* P. Henn. and note at end of this list.

L. manihotis (Syd. in Syd. & Butler) Petrak (1957) - see under *Ophiobolus manihotis* Syd. in Syd. and Butler.

L. maritimum (Sacc.) Petrak (1952) - based on *Rhaphidophora maritima* Sacc.; type sterile; for description and synonymy see Walker (1972); not a *Linocarpon*, but the exact identity of this species, described with fragmenting ascospores, is not known; see also *Ophiobolus maritimus*.

L. medusae (Ell. & Ev.) Petrak (1952) - now placed as *Lulworthia medusae* (Ell. & Ev.) Cribb & Cribb (1955); see under *Ophiobolus medusae* Ell. & Ev.

L. muroianum Hino & Katumoto (1966) - placed here as *Plagiosphaera muroiana* (Hino & Katumoto) Walker (q.v.).

L. nipae (P. Henn.) Schrantz (1961) - combination not validly published (Art.33); see under *Ophiobolus nipae* P. Henn. and note at end of this list.

L. oryzinum (Sacc.) Petrak (1952) - this is *Gaeumannomyces graminis* (Sacc.) von Arx & Olivier var. *graminis* (q.v.).

L. palmetto (Ell. & Ev.) Barr (1978) - described originally as *Linospora palmetto* Ell. & Ev. (1887) and transferred by Barr (1978) to *Linocarpon* after study of the type.

L. stipae Hansford (1954) - redisposed here as *Ophiosphaerella stipae* (Hansf.) Walker (q.v.).

L. umbelliferarum Barr (1961) - transferred by Barr (1978) as *Plagiosphaera umbelliferarum* (Barr) Barr (q.v.).

L. verminosum (Mont.) Schrantz (1961) - combination not validly published (Art.33); see under *Ophiobolus verminosus* (Mont.) Sacc.

L. versisporum (Ell. & Mart.) Petrak (1952) - based on *Ophiobolus versisporus* Ell. & Mart. (1885) on *Sabal*, this is considered by Barr (1978) as a true *Linocarpon*, with ascospores similar to those of *L. palmetto* (also on *Sabal*), broadest in the upper third and tapering to the base. Ellis and Martin (1885) described the ascospores of *L.versisporum* as 60-70 x 2-2.5 μm, somewhat larger than those described for *L. palmetto*.

L. williamsii Hansford (1954) - placed here as *Ophiosphaerella williamsii* (Hansf.) Walker (q.v.).

In the sense of the generic type, *Linocarpon* is readily distinguished from genera such as *Gaeumannomyces*, *Linospora* and *Plagiosphaera* (see also Barr, 1978) and consists of several species found mainly on dead leaves and petioles of Palmae, with fewer records on other hosts. Of the species considered here, five are accepted in *Linocarpon* - *L. pandani*, *L. cajani*, *L. elaeidis*, *L. palmetto* and *L. versisporum*. The relationship of these to one another and to some *Ophiobolus* species on Palmae such as *Ophiobolus oedema* (Mont.) Sacc., *O. licualae* Syd., *O. livistonae* P. Henn., *O. nipae* P.Henn. and *O. verminosus* (Mont.) Sacc. requires further study. The Montagne species could well provide earlier epithets in *Linocarpon* for some of these palm fungi.

LINOSPORA

Linospora Fuckel, *Jahrbücher des Nassauischen Vereins für Naturkunde* 23-24, 123, 1870. Type sp. *L. capreae* (DC) Fckl.

Linospora is characterised by oblique or horizontal perithecia surrounded by a pseudostroma embedded in the substrate, and limited by a dark clypeus, a long protruding lateral beak, unitunicate asci with an apical ring, and hyaline filiform ascospores. The type species *L. capreae*, occurs on dead fallen leaves of *Salix*, and has been described frequently (von Arx and Olivier, 1952; Barr, 1978; Dennis, 1968; Munk, 1957). Several *Linospora* names are dealt with by Barr (1978).

Six species described originally in *Linospora* have been examined and found to belong to other genera. They are disposed as follows:-

Linospora antarctica Speg. - redisposed as *Sphaerulina antarctica* (Speg.) Walker (q.v.).

Linospora magellanica Speg. - redisposed as *Lophodermium magellanicum* (Speg.) Walker (q.v.).

Linospora palmetto Ell. & Ev. - transferred by Barr (1978) as *Linocarpon palmetto* (Ell.& Ev.) Barr (q.v.).

Linospora pandani Rehm - placed here as a synonym of *Linocarpon pandani* (Syd.) Syd. (q.v.).

Linospora prunellae Ell.& Ev. - see discussion of *Ophiobolus rostrupii* under *Leptosporopsis*.

Linospora pulchella Speg. - reduced to synonymy under *Gaeumannomyces graminis* (Sacc.) von Arx & Olivier var.

graminis (q.v.).

LOPHODERMIUM

Lophodermium Chevallier, *Fl.Paris* **1**, 435, 1826 (from Darker, 1967). Type sp. *L. arundinaceum* (Schrad. ex St. Amans) Chev.

Generic and specific synonyms and other nomenclatural details are given for twenty one species by Darker (1967). Several species are described by Tehon (1935, under various generic names) and Terrier (1942). Two species seen on Gramineae are considered here.

Lophodermium gramineum (Fr.) Chev.: on dead leaves of *Bromus unioloides* H.B.K., in sandhills, Tuggerah Lakes, *N.S.W., Australia*, 14.v.1969, J. Walker DAR 17198.

In this locality, the few host plants present were heavily infected. The fungus agreed with the description of *L. gramineum* given by Tehon (1935).

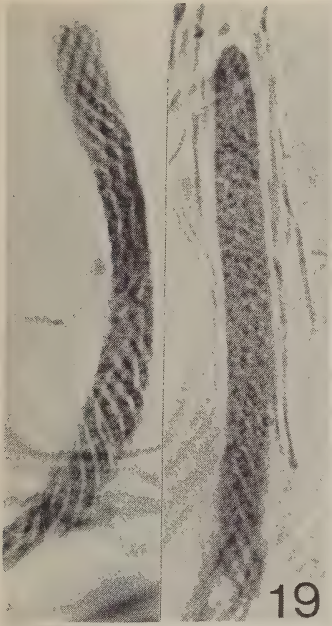
Lophodermium magellanicum (Speg.) Walker comb.nov.
≡ *Linospora magellanica* Speg., *Bol.Acad.Nac.Cienc. Republ.Argent.Cordoba* **27** (4), 378-379, 1924 (type in LPS !)

Perithecia (Figs.20-23) embedded in leaf, subepidermal, black, oval in outline, up to 400-500 µm long, 250 µm wide, opening by a longitudinal slit, wall with labia up to 40 µm thick on either side of slit, thinner at sides, 15-20 µm thick at base, dark brown to black outside, paler inside, composed of cells 7-10 µm diam forming a pseudoparenchyma, in surface view brown hyphae clearly seen at margin of perithecia, hyphae developing below and in host epidermal cells, which are packed with small dark fungal cells. *Asci* (Figs.21-23) developing in basal layer, cylindrical to more commonly obclavate, usually widest about one quarter the height above the base, tapering gradually to the slightly thickened rounded apex and more sharply to the flattened base, no apical apparatus seen, up to 90 x 17 µm, eight-spored. *Ascospores* (Figs.21-23) long cylindrical (bacillary), straight but usually sinuate or curved towards the apex which is rounded and occasionally very slightly swollen, base slightly narrower, non-septate, 35-40 x 2-2.5 µm, completely surrounded by a hyaline sheath 2-2.5 µm thick, lying at 2-3 levels in the ascus. *Paraphyses* thin, hyaline, probably septate, as long as or longer than the asci.

Illustrations: Spegazzini (1924, habit, section ascocarp, asci, ascospores, paraphyses).

Specimen examined: on dead leaves of *Festuca purpurascens* Banks & Soland., Sholl Bay, Capitan Aracana Island, Chile, 13.i.1924, C. Spegazzini LPS 881, HOLOTYPE (slides as DAR 33290).

Spegazzini (1924) described the lenticular perithecia as 150-160 µm diam with a central ostiole. However, his pencil drawing on the type packet (similar to the published illustration) shows an oval fruiting body 250 x 150-160 µm like those on the specimen. Some perithecia were immature with the ostiolar slit poorly developed and these appeared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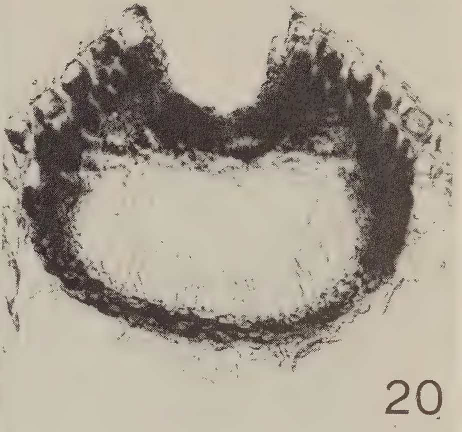
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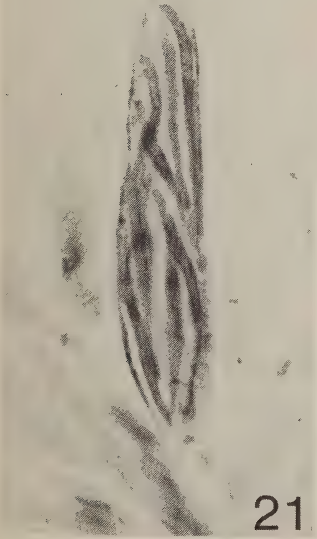
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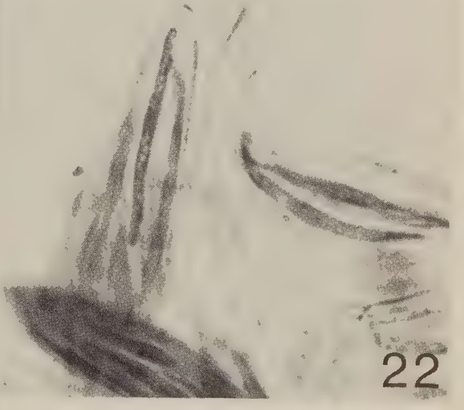
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Figures 19-22. 19. Leptospora implexa, two asci with spiralled ascospores, x 733, from holotype in NY (slide DAR 33682). 20-22. Lophodermium magellanicum, from holotype, LPS 881 (slide DAR 33290). 20. Cross-section ascocarp, x 183. 21-22. Asci with ascospores, x 733.

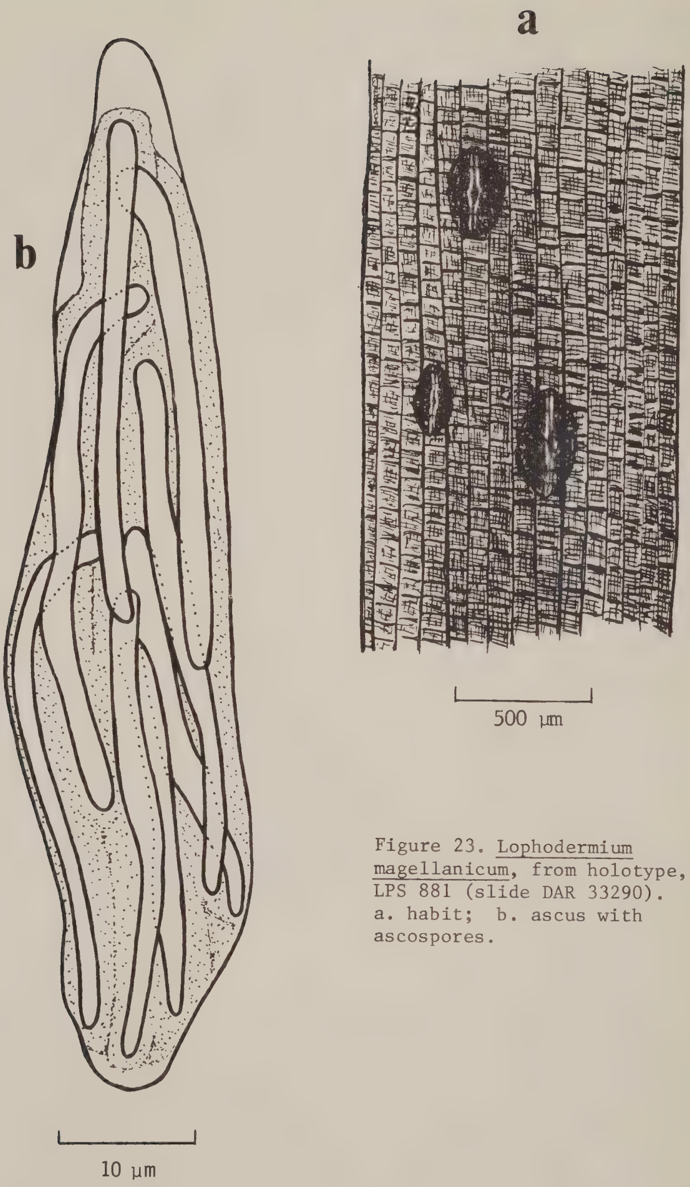

a
b
500 µm
10 µm

Figure 23. Lophodermium magellanicum, from holotype, LPS 881 (slide DAR 33290). a. habit; b. ascus with ascospores.

superficially to have a round central pore. Asci, ascospores and paraphyses agreed with those described and figured by Spegazzini (1924), except that he did not mention the spore sheath.

L. magellanicum is a typical *Lophodermium*. Of the several species described from Gramineae, it is similar to the fungus described and figured (Plate 8, Fig.4) by Terrier (1942) as *L. alpinum* (Rehm) Rehm, described originally as *L. arundinaceum* var. *alpinum* from a collection on *Nardus stricta*. Terrier (1942) thought that two distinct *Lophodermium* spp. were present on Rehm's type and that his description perhaps combined characters of both. Although it is very similar to the fungus Terrier described, Spegazzini's species is best kept separate until the above problem is resolved. Terrier (1942) listed another collection of *L. alpinum* from Switzerland on *Festuca*, and Savile (1959) listed Arctic collections on species of *Elymus*, *Festuca* and *Pucciniella*. His description of mature asci as (10) 12-16 μm wide and ascospores (1.8) 2.2-2.8 (3) μm wide is similar to those of *L. magellanicum*.

The detailed locality information given for this species (and for *Sphaerulina antarctica* (Speg.) Walker, collected at the same time) is slightly confused. On Spegazzini's original packet, the only locality given is Sholl Bay (in his handwriting) and this is repeated in Spegazzini (1924). The locality Sholl Bay, Capitan Aracana Island, Chile is typed on the outer packet. Farr (1973) gives it as Tierra del Fuego, South America and Cash (1972) as Sholl Bay, Southern Republic of Argentina. All seem to be referring to the same place.

LULWORTHIA

For a discussion of the genus, see Kohlmeyer (1972). The two species *L. halima* (Diehl & Mounce) Cribb & Cribb and *L. medusae* (Ell.& Ev.) Cribb & Cribb are mentioned briefly under their previous *Linocarpon* and *Ophiobolus* names (q.v.).

MICROSTELIUM

Microstelium Patouillard, *Bull.Soc.Mycol.Fr.* **15**, 208, 1899.
Type sp. *M.hyalinum* Pat. (type in FH !)

This genus, described from bark encrusted with algae and mosses, was characterised by sparse, cylindrical, apically obtuse, stipitate, fleshy-coriaceous perithecia, 1 mm high, perhaps with an apical pore, very long cylindrical asci 8-10 μm wide and filiform ascospores as long as the asci, breaking into many fragments 6-8 μm long. Filiform paraphyses were also said to be present. The perithecial wall was brownish violet in colour and composed of an inner layer of very long thin brown parallel hyphae whose thickened tips turned towards the outside and formed the outer wall layer. A white superficial mycelium was described and the genus was said to be related to Barya and Acrospermum.

The type specimen in FH is very small and appears to be a mixture of dried moss and moss rhizoids. A note in the type packet reads 'Peut-être un lichen?'. No sign of any fungal structures was seen. The so-called Microstelium perithecia seem to be the erect dried tips of young rhizoids. These are dark brown with darker blackened tips and have dried to a flinty consistency very difficult to section. No asci, ascospores or ascocarp wall structures were seen in slides prepared from this specimen. It is suggested that the genus may have been based on moss rhizoids blackened at their tips.

Illustrations: Patouillard (1899, habit, ascocarps and cells of outer wall).

Specimen examined: on bark of a living tree, near Bains-Larmes, Guadeloupe, no date or collectors name, 1070, Pat. herb.sht. 6616, FH, HOLOTYPE (two slides as DAR 33736).

OPHIOBOLUS

Ophiobolus Riess, Hedwigia 1 (6), 27-28, 1854.
Type sp. O.disseminans Riess, now O.acuminatus (Sow. ex. Fr.) Duby ap. Rabh.

The strict generic concept adopted by Holm (1957) and followed in the works of Luttrell (1973) and von Arx and Müller (1975) is accepted here. As there does not appear to be a recent description of the generic type specimen, one is given here.

Ophiobolus acuminatus (Sow.ex Fr.) Duby ap. Rabh.
= O.disseminans Riess, Hedw.1 (6), 27-28, 1854 (Rabh.Herb.Myc. I n. 1823, duplicate in M !)

A more extensive synonymy is given by Müller (1952) and Holm (1957).

Pseudothecia (Fig.25) embedded in dead stem, black, with erumpent necks, many broken off, ostiole seen from above as a minute white circular area with surrounding black wall and central pore. Pseudothecia roughly pyriform, body globose, embedded in spongy cortical stem tissue, base resting on harder woody internal tissue, joined to a loose to dense brown mycelium in stem cortex, 300-450 µm high (including neck), 250-300 µm diam, wall 25-30 µm thick, somewhat thicker near junction of neck, of several (8-12) layers of cells, outer layers very dark brown and cells with thickened walls, inner layers of thinner walled pale brown to hyaline radially flattened cells 9-12 x 6-8 µm; neck 50-100 µm long (many broken and perhaps originally longer), 50-75 µm wide, lined internally with hyaline periphyses, ostiolar canal 20-25 µm diam. Asci (Fig.26) abundant, long cylindrical with narrower short basal stalk terminating in a foot-like base, bitunicate, 130-150 x 10-12 µm, many not fully mature, apical apparatus not seen (not studied in detail), eight-spored. Ascospores (Fig.24) long cylindrical, brown in mass, pale brown singly, lying parallel or more commonly slightly spirally twisted in the ascus, 120-150 x 2-3 µm, tapering slightly near each end, ends rounded, spores breaking easily into two

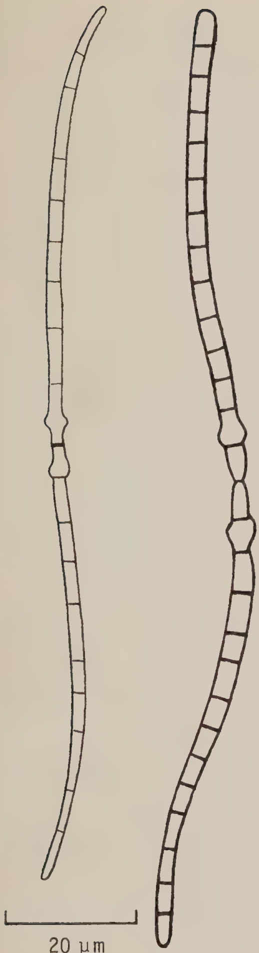


Figure 24. *Ophiobolus acuminatus*, ascospores. a. young spore from isotype of *O.disseminans* in M (slide DAR 32063); b. from specimen in K as *Sphaeria penicillus* (slide DAR 33308).

halves at the central septum, the second cell on either side being swollen, several (20-25) septa per spore, some septa more prominent than others. *Pseudoparaphyses* abundant, hyaline, septate, longer than the asci, 2-2.5 µm wide.

Illustrations: Dennis (1968, habit, ascus, ascospores); Holm (1957, ascospore); Müller (1952, section ascocarp, ascospores); Shoemaker (1976, section ascocarp, ascus, ascospores).

Specimen examined: on dry dead stem of *Cirsium arvense* (L.) Scop. (as *Carduus arvensis*), near Kassel, Germany, spring 1853 (Rabh.*Herb*.*Myc*.I n. 1823) in M, ISOTYPE (slides as DAR 32063).

The above description agrees very well with that given by Müller (1952, as *O.acuminatus*) but measurements of asci and ascospores are somewhat smaller than those given by Holm (1957, asci 150-190 x 9-10 µm; ascospores 120-165 x 3.5-5 µm) and Shoemaker (1976, asci 150-190 x 13-17 µm; ascospores 140-180 x 3-4 µm), both as *O.acuminatus*. Many ascocarps on the type specimen seemed to be not fully mature.

Many scolecospored fungi have been placed in *Ophiobolus* by Saccardo (1883) and later workers, and *Ophiobolus* names in the literature now refer to a wide range of scolecospored perithecial and pseudothecial species. In current work on the take-all fungi of cereals and grasses (Walker, 1972, 1980), many *Ophiobolus* names have been considered and type specimens of several examined. These are listed in alphabetical order of specific epithet with comments on the disposition accepted here for each species. Full synonymy will be found either in the references listed, or under the name in this chapter where the species is treated.

Ophiobolus andropogonis Ell.& Ev., *Proc.Acad.Nat.Sci.Phil*.1893, 448, 1894.

Exact identity not known. The sheet in NY bears two packets and a description. The two packets are (i) on *Vetiveria zizanioides* (L.) Nash (formerly as *Andropogon muricatus*), St.Martinsville, Louisiana, 9.iii.1889, A.B.Langlois 1687, which is empty, with a note reading 'empty 3/31/67' and (ii) same host and locality, Jan.1890, Langlois 2209 (partly) (slides as DAR 33737) which contains several grass leaf sheaths bearing pseudothecia of a species of *Ophiosphaerella*, similar to *O. herpotricha* (Fr.) Walker (q.v.). The note on the packet is headed '*Ophiobolus andropogonis* E.& E.', gives details for Langlois 1687, and describes a fungus with ascocarps 400 x 300 µm, asci 100-120 x 10 µm, ascospores nearly as long as the asci and 2.5 µm wide, paraphyses present. The name '*O.andropogonis*' on this note has been crossed out and '*O.medusae* E.& E.' written in. This description is very similar to that of *O.medusae* var. *minor* Ell.& Ev.(1890) described from another collection (Langlois 1771) made at St. Martinsville on *Vetiveria zizanioides* (as *Andropogon muricatus*) in Feb.1889. This collection has not been located but Meyers (1957), in proposing the new name *Ophiobolus salinus* for *O.medusae* var. *minor*, stated that an examination of the type material showed a fungus with paraphyses, and ascospores 90-110 x 2.5 µm with no appendages. This is also similar to the description of Langlois 1687 given on the NY sheet of *O.andropogonis*.

When describing *O.andropogonis*, Ellis and Everhart (1894) stated that, in their North American Pyrenomycetes (Ellis and Everhart, 1892), they had included it under *O. medusae* (where they list two collections on *Spartina* and *Vetiveria zizanioides*, as *Andropogon muricatus*), but they now regard it as a separate species, with clavate cylindrical asci 60-80 x 8-10 µm, straight multiseptate ascospores 40-80 x 2-2.5 µm and abundant paraphyses. The only collection they quote is on *V.zizanioides* (as *A.muricatus*), Louisiana, Langlois (without number).

This published description does not agree either with the description on the note in NY (based on Langlois 1687) or with the fungus found on Langlois 2209. From the note, Langlois 1687 would seem to have been intended originally as the type collection. Until it (or a duplicate) or other Ellis and Everhart material labelled *O.andropogonis* can be examined, the discripancy between the available material (and herbarium note) and the published description cannot be resolved and the exact identity of *O.andropogonis* (and of the similar *O.medusae* var. *minor* on the same host) remains unknown. (See also under *Ophiosphaerella herpotricha*).

Ophiobolus arenarius Bomm., Rouss. & Sacc. in Sacc., *Syll. fung.* 9, 935, 1901 (type in PAD, not seen)

Described from the type by Eriksson (1967) and transferred as *Plejobolus arenarius* (Bomm.,Rouss.& Sacc. in Sacc.) O.Erkiss., the type species of *Plejobolus*; also described and figured from a Scottish collection on the type host *Ammophila arenaria* (L.) Link by Dennis (1975). The clypeate perithecia with an eccentric neck contain bitunicate asci up to 400 x 10 µm with hyaline ascospores almost as long, 2-2.5 µm wide, breaking at maturity before discharge into part-spores 4-6 µm long.

Ophiobolus australiensis Johnson & Sparrow, Fungi in oceans and estuaries, p.419, 1961.

A *nom.nov.* for *O.littoralis* Cribb & Cribb (non *O. littoralis* (Crouan) Sacc.) on roots of *Avicennia* in Queensland.

Ophiobolus barbatus Pat. & Gail.(1888) - the type species of *Acanthotheciella* Höhn. (1911) (q.v.).

Ophiobolus brachysporus Fautr. & Roum. (from Saccardo, 1895) - a synonym of *Plagiosphaera immersa* (Trail) Petrak (q.v.).

Ophiobolus cariceti (Berk.& Br.) Sacc. (1883) - see under *Sphaeria cariceti*.

Ophiobolus chaetophorus (Crouan) Sacc. (1883) - a synonym of *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (q.v.).

Ophiobolus coffeatus (Berk.in Hook.) Sacc.(1883) - see under *Sphaeria coffeata*.

Ophiobolus compressus Rehm (1881) - treated here,following Holm (1957), as *Leptosphaeria compressa* (Rehm) Holm (q.v.).

Ophiobolus culmorum (Crouan) Sacc. (1883) - see under *Sphaeria culmorum* Crouan.

Ophiobolus disseminans Riess (1854) - the type species of *Ophiobolus* Riess, now placed as a synonym of *O.acuminatus* (see above).

Ophiobolus eucryptus (Berk.& Br.) Sacc.(1883) - see under *Sphaeria eucrypta*.

Ophiobolus gracilis (Niessl) Müller (1952) - a synonym of *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (q.v.).

Ophiobolus graminicola (Speg.) Petr.& Syd. (1936) (as '*graminicolus*') - this is the type species of *Ophiosphaerella* Speg. (q.v.).

Ophiobolus graminis (Sacc.) Sacc. in Roum.& Sacc. (1881) - the type species of *Gaeumannomyces*, placed here as *G. graminis* (Sacc.) von Arx & Olivier var. *graminis* (q.v.). The various uses of this name in plant pathological literature are discussed in detail by Walker (1980).

Ophiobolus graminis var.*avenae* Turner (1940) - placed here as *Gaeumannomyces graminis* (Sacc.) von Arx & Olivier var. *avenae* (Turner) Dennis (q.v.).

Ophiobolus halimus Diehl & Mounce, in Mounce & Diehl (1934) - found on *Zostera marina* L. in Canada and now placed as *Lulworthia halima* (Diehl & Mounce) Cribb & Cribb (1955).

Placed in *Linocarpon* by Petrak (1952) but this opinion not accepted here.

Ophiobolus helicosporus (Berk.& Br.) Sacc. (1883) - placed here as *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (q.v.).

Ophiobolus herpotrichus (Fr.) Sacc. in Roum. & Sacc. (1881) - placed here as *Ophiosphaerella herpotricha* (Fr.) Walker (q.v.).

Ophiobolus heterostrophus Drechs., *J.agric.Res.* **31**, 723-724, 1925, (type not studied) - transferred as *Cochliobolus heterostrophus* (Drechsler) Drechsler (1934), the type species of *Cochliobolus*. This genus and its associated conidial states have not been studied here.

Ophiobolus immersus Trail (1889) - see *Plagiosphaera immersa* (Trail) Petrak.

Ophiobolus implexus (Ell.& Ev.) Ell.& Ev. (1892) - not an *Ophiobolus* Riess sens. str.: placed here as *Leptospora implexa* (Ell.& Ev.) Walker (q.v.)

Ophiobolus incomptus (Car.& de Not.) Sacc. (1883) - see under *Ophiochaeta incompta*.

Ophiobolus junci Miller & Burton, *Mycologia* **34**, 7, 1942 (type not seen).

From the description and figures, this species with large ascocarps 300-800 µm diam embedded in dead stems, with cylindrical apically thickened asci 138-160 x 14-16µm, septate ascospores yellowish to brown 115-138 x 4-5 µm, abundant paraphyses, could well be a species of *Ophiosphaerella* (q.v.).

Ophiobolus leptospermus (Speg.) Sacc. (1883) - placed here as *Ophiosphaerella leptosperma* (Speg.) Walker (q.v.).

Ophiobolus leptosporus Saccas, *L'Agronomie Tropicale* *9* (3), 281-282, 1954 (type not located).

The type specimen could not be obtained. It is not at PC and enquiries made to the Central Phytopathological Station, Boukoko, Central African Republic and to Dr. Saccas failed to locate it. The original collection was made on dead leaf sheaths of *Sorghum vulgare* L. at M'Baiki, Central African Republic in 1953, and the description and figures indicate a possible Pleosporaceous species, with dark brown immersed ascocarps 350-600 x 250-450 µm, erumpent neck 80-100 µm long, cylindrical asci 96-195 x 4.7-5.5 µm, thickened above, with eight cylindrical filiform pale yellowish ascospores 85-175 x 1-1.5 µm, 7-14 septate and spirally twisted 2-3 times in the ascus. Numerous paraphyses were present and the host tissues were discoloured red.

With its thin asci, and thin spiralled ascospores, *O. leptosporus* is probably a species of *Leptospora*. Its asci and ascospores are of similar length to those of *L.implexa* (on *Sorghum halepense*) but the asci of *O.leptosporus* are only half as wide. They are similar in width to the asci of *L.rubella*, but asci and ascospores of *L.rubella* are much longer. There is a reddish discolouration of the substrate, as occurs commonly with *L.rubella*, but reddish discolouration is a reaction of *Sorghum* spp. to a wide range of organisms and injuries. Tarr (1962) commented on the similarity of *O.leptosporus* to *Leptospora rubella* (as *Ophiobolus porphyrogonus* (Tode) Sacc.). *O.leptosporus* also resembles *O.trichisporus* Ell.& Ev. described from dead grass culms and here placed tentatively under *Leptospora* (q.v.). *O.leptosporus* is not an *Ophiobolus* sens.str. but study of the type will be necessary to place it accurately.

Ophiobolus licualae Syd., *Philipp.J.Sci.* *9* (Sect.C. Nr.2), 165, 1914 (from *Syll.fung.* *24*, 1065-1066, 1926) (type not seen).

From the description, and from a superficial examination of five collections under this name in BPI, this species on dead palm petioles from the Philippines could well be a species of *Linocarpon*, possibly the same as one of the several species recorded on palms.

Ophiobolus littoralis (Crouan) Sacc. (1883) - see under *Sphaeria littoralis* Crouan.

Ophiobolus littoralis Cribb & Cribb, *Univ.Qd.Dept.Bot. Papers* *3* (12), 101-102, 1956 (type in BRIU, not seen) - a later homonym of *O.littoralis* (Crouan) Sacc.; renamed *Ophiobolus australiensis* Johnson & Sparrow (q.v.).

Ophiobolus livistonae P.Henn., *Hedwigia* *47*, 257, 1908 (type in K seen; not examined in detail).

≡ *Linocarpon livistonae* (P.Henn.) Schrantz, *Bull. Trimest. Soc.mycol.Fr.* *76* (1960), 337, 1961 (not validly published, Art.33).

The original description, and superficial examination of portion of the type collection (Copeland 524, in K) indicate that this fungus on dead *Livistona* (Palmae) petioles from the Philippines is a species of *Linocarpon*, but the Schrantz combination was not validly published. Several possible *Linocarpon* spp. on Palmae are listed under *Linocarpon* and the relationships of these require further study. Schrantz (1961) briefly described and figured a perithecium, ascus and ascospores.

Ophiobolus manihotis Syd. in Syd. & Butler (1911) - after study of portion of the type, Petrak (1957) transferred this name to *Linocarpon*. Petrak's (1952) wide concept of *Linocarpon* is not accepted here and, until *O. manihotis* has been studied further, the most suitable genus for it cannot be determined.

Ophiobolus maritimus (Sacc.) Sacc. (1883) - based on *Rhaphidophora maritima* Sacc.; type sterile; for description and synonymy, see Walker (1972). Höhnel (1920) briefly summarised the original description and suggested that it may be an undescribed Diaporthaceous genus. There is no evidence for this or any other placement of this species.

Ophiobolus medusae Ell.& Ev., *J.Mycol*.**1** (12), 150, 1885 as 'medusa' (type in NY !)
≡ *Linocarpon medusae* (Ell.& Ev.) Petrak, *Sydowia* **6**, 388, 1952.

This is *Lulworthia medusae* (Ell.& Ev.) Cribb & Cribb (1955). For a discussion of the genus *Lulworthia*, see Kohlmeyer (1972).

Ophiobolus medusae Ell.& Ev. var. *minor* Ell. & Ev., *Proc. Acad. Nat. Sci. Philadelphia* 1890, 239, 1890 (type not found).

For discussion of this species and specimen details, see under *Ophiobolus andropogonis* and *Ophiosphaerella herpotricha*; see also *Ophiobolus salinus* Meyers.

Ophiobolus medusae form *bromi* Brenckle, *Fungi Dakotensis* No. 536, 1923 (printed label on specimen).

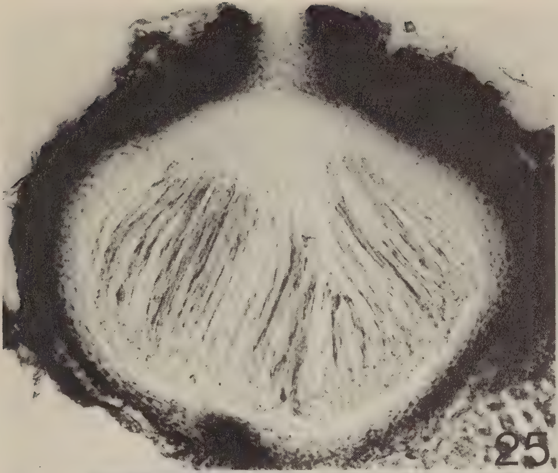
A specimen under this name in NY bears pseudothecia and pycnidia typical of *Ophiosphaerella herpotricha* (q.v.) where the name is listed in synonymy.

Ophiobolus moravicus Petrak (1921) - the type species of *Plagiosphaera* Petrak (q.v.).

Ophiobolus nipae P. Henn., *Hedwigia* **47**, 257, 1908 (type not seen)
≡ *Linocarpon nipae* (P.Henn.) Schrantz, *Bull.Trimest. Soc.mycol.Fr.* **76** (1960), 337, 1961 (not validly published, Art.33).

From the original description, and the illustrations of Schrantz (1961), this appears to be a *Linocarpon* similar to others recorded on various palms. For further discussions of these, see under *Linocarpon*.

Figures 25-30. 25 and 26. *Ophiobolus acuminatus*, section ascocarp, x 183, and ascus with young ascospores, x 733, from isotype of *O. disseminans* in M (slide DAR 32063). 27-30. *Ophioceras leptosporum*, ascocarp from dried type culture in K (slide DAR 31944). 27. Outer wall, x 183. 28. Detail of outer wall, x 733. 29. Apex of neck, x 183. 30. Detail of neck apex, x 733.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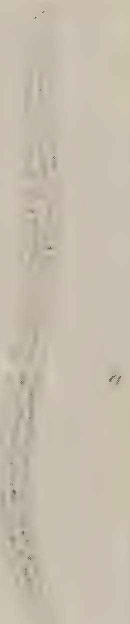
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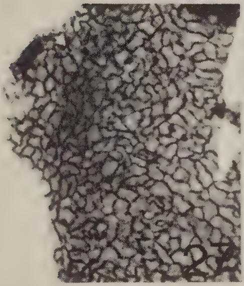
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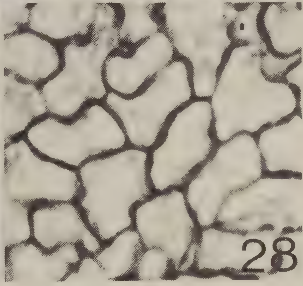
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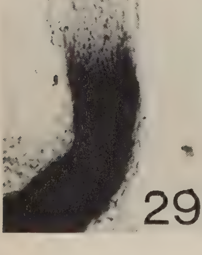
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Ophiobolus oedema (Mont.) Sacc., *Syll.fung.***2**, 351, 1883
≡ *Sphaeria oedema* Mont.,*Ann.Sci.Nat.Bot.***14**,326,1840
≡ *Rhaphidospora oedema* (Mont.) Ces.& de Not. (from Sacc., *Syll.fung.***2**, 351, 1883).

Described from petioles of *Mauritia flexuosa* L.f. (Palmae) in French Guiana, this species was said to have small black perithecia, with clavate asci 70 µm long and thin ascospores to 90 µm long. Superficial examination of what is possibly portion of the type collection in K indicates that it may be a *Linocarpon*. This species could well provide one of the earliest epithets for *Linocarpon* spp. on Palmae. These are discussed further under *Linocarpon*.

Ophiobolus ophioboloides (Sacc.) Holm, *Svensk Bot.Tidskr.* **42**, 345, 1948
≡ *Leptosphaeria ophioboloides* Sacc., *Misc.myc.*No.1,23, 1884 (original not seen; from Saccardo, *Syll.fung* **9**, 770, 1891)
≡ *Leptosphaeriopsis ophioboloides* (Sacc.) Berl., *Icon. fung.* **1**, 88-89, 1892.

A true species of *Ophiobolus* Riess sens. str. (Holm, 1957). For references to descriptions and illustrations, see under *Leptosphaeriopsis*.

Ophiobolus oryzae Miyake, *Bot.Mag.*(Tokyo) **23** (266), 96-97, 1909 (also in *J.Coll.Agric.Imp.Univ.Tokyo* **2**(4), 249-250, 1910) (type not seen).

Listed by Sawada (1959), and suggested by Shoemaker (1976), as a synonym of *Ophiobolus herpotrichus*; see discussions under *Ophiosphaerella herpotricha*.

Ophiobolus oryzinus Sacc. (1916) - a synonym of *Gaeumannomyces graminis* (Sacc.) von Arx & Olivier var.*graminis* (q.v.).

Ophiobolus paludosus (Feltg.) Sacc. & D.Sacc., *Syll.fung.* **17**, 774, 1905.
≡ *Leptosphaeria paludosa* Feltg.,*Vorst.Pilz.Luxemb.* Nachtr. II, 157, 1901.

For a discussion of this species and details of specimen examined, see under *Gaeumannomyces* spp. on Cyperaceae.

Ophiobolus pellitus (Fckl.) Sacc. - one of the species listed by Saccardo (1883) in *Ophiobolus* subgenus *Ophiochaeta* (see under *Ophiochaeta*); regarded by Holm (1957) as a synonym of *Nodulosphaeria erythrospora* (Riess) Holm; not studied.

Ophiobolus penicillus (Schm.ex Fr.) Sacc. in Roum.& Sacc. (1881), cited in error as '(K.et S.) Sacc.', citation corrected in *Syll.fung.***2**, 352, 1883 - see under *Sphaeria penicillus*.

Ophiobolus prunellae (Ell.& Ev.) Shoemaker (1976) - see discussion of *Ophiobolus rostrupii* under *Leptosporopsis*.

Ophiobolus rostrupii Ferd. & Winge (1909) - see discussion under *Leptosporopsis*.

Ophiobolus rubellus (Pers.ex Fr.) Sacc. in Roum. & Sacc. (1881) - see under *Leptospora rubella* (Pers.ex Fr.) Rabenh..

Ophiobolus salinus Meyers, *Mycologia* *49*, 518, 1957, as '*salina*'. Meyers (1957) proposed this as a new name for *O. medusae* var. *minor* Ell.& Ev., which he recognised as quite different from *O.medusae*. For discussion of *O. medusae* var. *minor*, see under *O. andropogonis* and *Ophiosphaerella herpotricha*.

Ophiobolus spirosporus Ahmad, *Sydowia* **2**, 75-76, 1948 (type not examined).

Two collections on the type host identified by Ahmad were examined. These agreed with the original description and showed a fungus with embedded black subglobose ascocarps with a short erumpent neck containing abundant broad clavate asci with eight hyaline filiform ascospores arranged in a dense spiral of several turns and abundant septate pseudoparaphyses. The asci are thin-walled but seem to be bitunicate. The ascospores were described originally as continuous, but are transversely septate at about 10 µm intervals with a finely granular vacuolate contents.

This is not an *Ophiobolus* Riess sens.str. and is probably better placed in *Cochliobolus*. With its thin asci and spirally arranged ascospores, it also shows some resemblance to fungi placed here in *Leptospora* but differs in its wide asci (9-12 µm) and hyaline ascospores. Study of the type specimen (and also of the fungus in culture) is necessary before any formal transfer is made.

Specimens examined: on dead culms of *Saccharum spontaneum* L.,Lahore, West Pakistan, 26.ii.1967, S. Ahmad, Fungi of West Pakistan 19764 in BPI (slides as DAR 33696); same, Fungi of West Pakistan 19767 in BPI (slides as DAR 34128); same date and locality, IMI 127027.

Ophiobolus stictisporus (Cke.& Ell.) Sacc. (1883) - based on *Sphaeria stictispora* Cke.& Ell.. The type has been examined and described by Walker (1972) who considered it a member of the Ostropales related to *Stictis*. In the Index (*Syll.fung.12*, Part 1, 481, 1897), the epithet is spelt incorrectly as '*strictisporus*'.

Ophiobolus stipae Doidge, *Bothalia* **4**, 212-213, 1941 (type in BPI and IMI examined).

O. stipae was described from a collection on dying leaf sheaths of *Stipa dregeana* Steud. from South Africa (Doidge (1950) listed the host as *S.dregeana* var. *elongata* Stapf).

It was said to have black ascocarps 250-350 µm diam, containing cylindrical clavate asci 100-150 x 7-8 µm, rounded and thickened at the apex, with filiform ascospores 100-120 x 2-2.6 µm, yellow-brown in mass and subhyaline singly, and abundant, hyaline filiform paraphyses 1 µm wide.

The fungus as described could not be found on two portions of the type collection examined. Abundant superficial growth of Meliola panici Earle was present and several small ascocarps of a species of Phaeosphaeria with three septate pale brown ascospores were seen on the portion in BPI. From the description, O.stipae could be a species of Ophiosphaerella but until it can be found on the available type material its exact identity remains in doubt.

Specimens examined: on Stipa dregeana, Xumeni Forest, near Donnybrook, Natal, South Africa, 5.ix.1937, K.E.Morgan & E.M.Doidge 29828 and 29829, TYPE collection, dups. as IMI 35983 and in BPI (slides as DAR 34129).

Ophiobolus tanaceti (Fckl.) Sacc.(1883) - see under Leptosphaeria tanaceti.

Ophiobolus tortilis Syd.,Ann.Myc.35, 263, 1937 (type not seen).

This was described from a collection on leaves and culms of Vetiveria zizanioides (as Andropogon zizanioides) in the Philippines. The dark brown clustered ascocarps had an immersed globose body 350-450 µm diam, with a thick obtuse conical erumpent neck, asci elongated clavate, narrower towards the sessile or shortly stalked base, 150-180 x 6.5-7.5 µm, containing eight greenish-yellow filiform ascospores, twisted in the ascus and as long as it, 1.5-2 µm wide, sometimes slightly narrower at the base, and somewhat curved or sigmoid singly. Septa were not mentioned but the contents were described as finely granular with several small oil droplets. Abundant thin septate paraphyses were present. Dark brown hyphae were present at the base of the ascocarps.

It has not been possible to obtain the type specimen. It is not present amongst the Sydow collections in S or B and Dr. B. Hein (B) suggested that it may have been destroyed. From the description, O.tortilis is very similar indeed to Leptospora implexa and may not be distinct from it. However, until the type is located, its exact identity remains unknown.

Ophiobolus trichellus Bomm., Rouss.& Sacc. in Sacc., Syll. fung.9, 934, 1891 (type not seen).
≡ Ophiochaeta trichella (Bomm.,Rouss.& Sacc.in Sacc.) Sacc., Syll.fung.11, Part 3, 352, 1895 (cited by Berlese, 1899, as '(B.R. et S.) Berl.').

According to Berlese (1899), the type specimen on leaves of *Ammophila* (as *Psamma*) *arenaria*, Belgium, is sterile and the exact identity of this fungus is not known. From the description, it is not an *Acanthophiobolus* (syn. *Ophiochaeta*) as considered here. See under *Ophiochaeta* for discussion of this generic name.

Ophiobolus trichisporus Ell.& Ev.(1890) - following Shoemaker (1976), this species is placed under *Leptospora rubella* (Pers.ex Fr.) Rabenh. and a description and discussion are given under that name. Saccardo (1891) listed it as *O.trichosporus* Ell.& Ev. and later (Saccardo, 1895) as *O.trechisporus* Ell.& Ev.

Ophiobolus verminosus (Mont.) Sacc., *Syll.fung.2*, 351,1883
≡ *Rhaphidospora verminosa* (Mont.) Mont., *Syll. Gen. Sp. crypt.*, 252, 1856
≡ *Sphaeria verminosa* Mont. (from Montagne,1856) (type not seen).
≡ *Linocarpon verminosum* (Mont.) Schrantz, *Bull.Trimest. Soc.Mycol.Fr.76* (1960), 337, 1961 (not validly published, Art.33).

From the original description (on palm petioles, Cayenne, French Guiana) and from the illustrations of a perithecium and an ascus given by Schrantz (1961), this is probably a species of *Linocarpon*. Petrak (1952) also considered it a typical *Linocarpon* but did not transfer it to this genus. For a discussion of several similar fungi on palms, see under *Linocarpon*.

Ophiobolus versisporus Ell.& Mart.(1885) - considered here as *Linocarpon versisporum* (Ell.& Mart.) Petrak (q.v.).

Ophiobolus zeae Saccas, *Rev.Path.veg.Entom.agric.Fr.30* (3), 183-186, 1951 (type in PC !)

Listed as a synonym of *Ophiosphaerella herpotricha* (Fr.) Walker (q.v.). Tarr (1962) thought it may be a *Cochliobolus* and stated 'If the generic name *Cochliobolus* be accepted for *Ophiobolus*-like fungi with spirally arranged ascospores (see Drechsler, 1934) this fungus should presumably be named *Cochliobolus zeae*'. Ascospore twisting in *Ophiosphaerella herpotricha* is discussed under that name.

Ophiobolus sp. (IMI 136978a on culms of *Chrysopogon*) - an immature *Ophiosphaerella* sp. (q.v.).

Ophiobolus sp. (IMI 71816 on *Axonopus*) - this is *Gaeumannomyces graminis* (Sacc.) von Arx & Olivier var. *graminis*.

Ophiobolus sp. (IMI 145643b, on leaf spot of *Zea mays* L., Khumal, Nepal, 15.viii.1969, slides as DAR 33294) - the only fungi seen were (a) ascocarps immature, possibly *Phaeosphaeria* sp. (b) *Pithomyces* sp.aff. *P.maydicus* (Sacc.) Ellis but most spores with three transverse septa.

Ophiobolus sp. (Padwick, 1950, p.153) - Padwick quoted a North American report of an *Ophiobolus* sp. on rice. The identity of this fungus is not known. *Gaeumannomyces graminis* var. *graminis* (q.v.) is known on rice in North America.

Ophiobolus sp. (Wadsworth, 1967) - the identity of this fungus associated with root rot of Bermuda grass (*Cynodon dactylon*) in the spring dead spot disease in the United States is not known and no specimen could be traced.

OPHIOCERAS

Ophioceras Saccardo, *Syll.fung.* **2**, 358, 1883.
Lectotype sp. *O. dolichostomum* (Berk.& Curt.) Sacc., *Syll.fung.* **2**, 358, 1883 (see Höhnel, 1911 for lectotypification).
≡ *Sphaeria dolichostoma* Berk.& Curt., *J.Linn.Soc. London* **10**, 388, 1869 (type not seen).

Conway and Barr (1977) described *O.dolichostomum* in detail from an isotype collection in NY and a 1968 collection on partially submerged wood from a stream in Florida. The genus is characterised by perithecia with a long (1-5 mm) beak, the peridium of the perithecial body being a textura angularis and of the beak a textura intricata, unitunicate asci with a chitinoid apical annulus and in some cases a subannular non-chitinoid globule, asci containing eight hyaline to faintly tinted septate scolecospores. Conway and Barr (1977) considered that these characters, and the hypersaprobic habit, indicate that *Ophioceras* should be excluded from Diaporthales and is placed best in the family Lasiosphaeriaceae, order Sordariales.

Other *Ophioceras* names

Ophioceras filiforme (P.Henn.) Höhnel (1911) - see under *Schizacrospermum filiforme*.

Ophioceras leptosporum (Iqbal) Walker comb. nov.
≡ *Gaeumannomyces leptosporus* Iqbal, *Trans.Brit.mycol. Soc.* **58** (2), 346-348, 1972 (type in K !)

Perithecia (Figs.29-31) with globose body and long filiform neck, on stem tissue body embedded or superficial, neck erumpent, in culture some perithecia with long necks completely embedded in agar, scattered singly or clustered into groups of 10-12 or more (especially in culture), body globose, dark brown to black, 250-300 (400) µm diam, wall 15-20 µm thick, easily broken when dry, of 4-5 layers of cells, outer layer a textura angularis of brown cells 10-16 x 10-13 µm (Figs.27 and 28), inner layers of paler flattened cells, neck dark brown to black, placed centrally on the body, 1-2(2.5) mm long, 40-60 (90) µm wide near the base, for most of its length 30-50 µm wide, 20-30 µm near the paler, thinner walled tip (Figs.29 and 30), wall of neck in lower part 20-25 µm thick, outer layer of roughly parallel rows of elongated dark cells 8-18 x 2.5-5 µm (textura porrecta) or cells more irregularly arranged

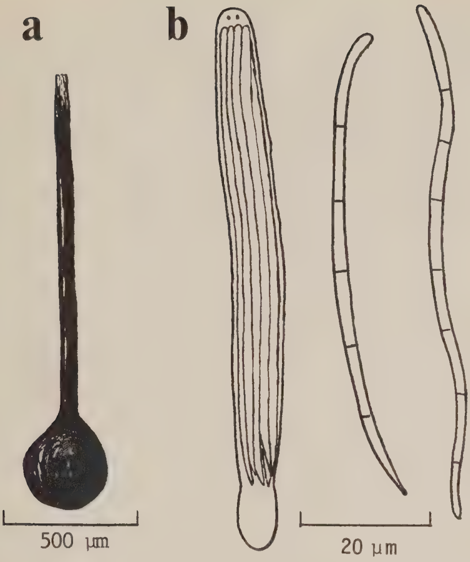


Figure 31. Ophioceras leptosporum. a. ascocarp, from holotype in K (slide DAR 33269); b. ascus and ascospores, from dried type culture in K (slide DAR 31944).

(textura angularis), except near the tip (apical 100-150 μm) where the wall is much paler and made up of thin septate pale brown to almost hyaline hyphae diagonally interwoven (textura intricata) (Figs.29 and 30); ostiolar canal 20-50 μm wide, periphyses not observed in perithecia from stem tissue, short upwardly pointing hyaline periphyses seen near to neck tip in perithecia in dried type culture. Asci (Fig. 31) cylindrical, straight or more often very slightly curved, (60) 70-95 (105) x 5-6 (7) μm, arising from a basal layer of hyaline gelatinising hyphae and eventually freed into the perithecial cavity, eight-spored, unitunicate, with a distinct refractive apical ring, seen in side view as two slightly elongated rods, 1-1.5 μm diam, 1.5-2 μm long. In a minority of asci, a small clear area 2-3 μm diam was seen between the apical ring and the tips of the ascospores. Ascospores (Fig.31) hyaline to faintly tinted singly, pale yellowish in mass, filiform, straight or more often slightly curved or sigmoid, apex rounded, often almost hemispherical, base acute, (65) 70-80 (85) x 1-1.5 μm, with 3-7 indistinct septa, contents finely granular and vacuolate, borne in a parallel fascicle in the ascus. Paraphyses not observed in either immature or mature perithecia but some hyaline non-staining material with little structure or occasionally with a few septate hyaline hyphae was seen between asci in several perithecia. Conidial state not known.

Illustrations: Iqbal (1972, ascocarps, asci, ascospores).

Specimens examined: on dead submerged stems of unidentified Umbelliferae, in river Creedy, near Cowley Bridge, Exeter, England, 6.ii.1970, S.H. Iqbal, K, HOLOTYPE (slides as DAR 33269); same locality, dried cultures with perithecia, K, dried type culture (slides as DAR 31944); same, type culture, CBS 894.70 (dried culture and slides as DAR 33738); on decaying submerged unidentified leaves, 24 km from Port Moresby, Papua New Guinea, March 1976, PNG 10147 (dried culture and slides as

DAR 34111).

O. leptosporum cannot be retained in *Gaeumannomyces*, whose known species are root, crown, lower stem and leaf sheath parasites of Gramineae and Cyperaceae, with a well developed superficial hyphopodiate mycelium and perithecial wall surface a textura epidermoidea. From the few collections known, *O.leptosporum* is a saprophyte on dead, decaying plant material in an aquatic environment. Its perithecia have an outer wall layer composed of a textura angularis and, at least near the tip, the cells of the outer layer of the neck approach a textura intricata. No superficial mycelium is associated with the perithecia in nature and, in culture, hyphae do not develop hyphopodia when inoculated onto a range of living and dead plant substrates, including cereal coleoptiles (Shaw, 1977). Tests by the present author with both the type culture and the Papua New Guinea isolate confirmed these results. Shaw (1977) described and figured ascospore germination, with formation of dark brown appressoria, 7.5-10.5 x 3.5-4.5 μm, usually terminal on the germ tube, occasionally intercalary, or almost sessile on the ascospore. However, formation of appressoria is a widespread phenomenon in the fungi (Emmett and Parbery, 1975; Parbery and Emmett, 1977) and bears no obligate relationship to the formation of mycelial hyphopodia (see discussion at end).

Conway and Barr (1977) described ejection of whole asci from the perithecium of *O.dolichostomum*. 'The unitunicate asci become detached from the subhymenium and under moist conditions some are discharged as a unit with the ascospores from the ostiole (Fig.2). Some asci are shot several centimetres from the ascocarp as they explode from the ostiole. Most, however, are trapped at the tip of the beak as shown in Figure 2'. This figure shows a white mass of asci and ascospores at the tip of the neck, and is very similar to Plate 1E of Shaw (1977) who described how whole asci of *O.leptosporum* in Papua New Guinea are extruded when perithecia are placed at a lower humidity. In this species, the asci and ascospores also accumulate at the tip of the neck, in a white milky globule, changing to honey colour later (Shaw,1977). *O.dolichostomum* and *O.leptosporum* seem to be closely related fungi, although the ascospores described for *O.dolichostomum* are longer and distinctly wider than those of *O.leptosporum*.

Barr (1978) considered that *G.leptosporus* was probably the same as *Plagiosphaera umbelliferarum* (q.v.). Comparison of the type specimens indicates that they are distinct and that *G.leptosporus* is better placed in *Ophioceras*. She also mentioned that Iqbal (1972) described perithecia in culture as oblique with lateral beaks. Study of material both on the host and in culture has shown that beaks arise centrally in both cases, although in culture perithecia may lie in various positions and beaks embedded completely in the agar may be slightly twisted. Iqbal (1972) described the position when he wrote 'When the ostiole has fully grown, it appears to arise laterally from the perithecium and the perithecia are obliquely horizontal. Nevertheless, perithecia are globose and ostioles arise from the apex'. His illustrations also show this.

Iqbal (1972) cited the holotype as specimen 2955 in the Mycological Herbarium, University of Exeter. Searches there failed to find it. Enquiries revealed that the specimen had been taken by Dr.Iqbal for further study and later forwarded to Dr. R.W.G. Dennis for permanent filing in Herb. K, where it now remains (Professor J. Webster, *in litt*.).

Ophioceras sorghi Saccas, *L'Agronomie Tropicale* *9*(3), 285-286, 1954 (type not located).

The type specimen could not be obtained. It is not in PC and enquiries made to the Central Phytopathological Station, Boukoko, Central African Republic and to Dr.Saccas failed to locate it. *O.sorghi* was described from dead stalks of *Sorghum vulgare* collected at M'Baiki, Central African Republic. The description and figure show globose to subglobose black immersed ascocarps, 300-400 µm diam with an erumpent straight to sinuous neck 350-700 µm long, 100-140 µm wide, containing thin-walled cylindrical-clavate slightly curved asci, 85-110 x 12-14 µm, sessile or slightly stipitate, obtuse apex, eight-spored, and ascospores filiform, cylindrical, slightly curved, rounded apex and slightly thinner rounded base, 75-95 x 3-4 µm, 3-12 indistinct transverse septa and arranged parallel in the ascus; paraphyses not observed.

The description, measurements and figures bear a striking resemblance to the perithecia, asci and ascospores of *Gaeumannomyces graminis* (compare Fig.35 of Saccas, 1954 with his Fig.32 labelled '*Ophiobolus graminis*' on *Sorghum*, and with other illustrations of *G.graminis*, see Walker, 1980). The long ascocarp neck is not inconsistent with this as neck length in *G.graminis* is very variable between collections and seems to depend on factors such as depth of ascocarps in host tissue, numbers of layers of leaf sheaths to be penetrated, and humidity (Walker, 1980). *G.graminis* var. *graminis* occurs commonly in tropical Africa (see above) and has a wide host range in the Gramineae. However, in the absence of the type specimen, of an exact knowledge of the ascus type, and of correlated mycelial characters (hyphopodia in particular), the placement of *Ophioceras sorghi* with *G.graminis* (possibly var. *graminis*) must remain conjectural. Tarr (1962) paraphrased the original description and commented that *O.sorghi* was apparently distinct from *Ophioceras zeae* Saccas on maize and from other species on grasses.

Ophioceras zeae Saccas, *Rev.Path.veg.Entom.agric.Fr.* *30* (3), 186-188, 1951 (type not located).

The type specimen is not in PC and enquiries similar to those made for *O.sorghi* Saccas could not locate it. The original collection is on stems and leaf sheaths of Zea mays from maize plantations near Boukoko, Central African Republic in October, 1950. The original description and figures indicate superficial, or partially embedded black, globose to subglobose ascocarps, 450-650 µm diam, with a long black neck, paler in its upper quarter, 350-900 x 90-125 µm, with cylindrical to fusiform, thick-walled shortly stalked asci, 55-65 x 7-8 µm, containing eight ascospores which are cylindrical to fusiform, at first multiguttulate and hyaline, later nonguttulate and pale yellowish, straight or more usually curved towards each end, ends rounded, always with three transverse septa, 39-50 x 2.3-2.5 µm; paraphyses not observed.

This is not an Ophioceras in the sense of the lectotype species, O.dolichostomum. With its three-septate ascospores with rounded ends and no paraphyses, it resembles some species placed in Sphaerulina Sacc. (Barr, 1972), but the large superficial ascocarps with a long neck are not characteristic of this genus. The description does not allow the nature of the asci (unitunicate or bitunicate) and other characters to be determined and, until the type specimen is found, the exact characteristics and generic placement of O.zeae remain unknown. As Tarr (1962) suggested, it seems quite distinct from O.sorghi Saccas.

OPHIOCHAETA

Ophiochaeta (Saccardo) Saccardo, Syll.fung.11, Part 3, 352, 1895.
≡ Ophiobolus Riess sensu Sacc. subgenus Ophiochaeta Sacc., Syll.fung.2, 352, 1883.
Lectotype sp. O.gracilis (Niessl) Sacc. (see below)

The literature on Ophiochaeta is confused. A chronological summary of its history is given, followed by a discussion of its typification, a list of several Ophiochaeta names and their proposed disposition.

1883 - Saccardo (1883) adopted a wide concept of the genus Ophiobolus Riess, including in it many scolecospored species now considered to belong in diverse genera. He divided the genus into two sub-genera : Eu-ophiobolus with subglabrous perithecia and Ophiochaeta with perithecia setulose, at least near the ostiole. No type species was designated for subgenus Ophiochaeta but under it he listed the following Ophiobolus spp. in this order : O.penicillus (Schmidt ex Fr.) Sacc., O.herpotrichus (Fr.) Sacc., O.pellitus (Fckl.) Sacc., O.chaetophorus (Crouan) Sacc. and O.incomptus (Car.& de Not.) Sacc..

1892 - Berlese (1892) placed setose species in his new genus Acanthophiobolus and modified the concept of the sub-genus Ophiochaeta to include species attached to a meandering basal mycelium. He designated Ophiobolus herpotrichus as the sub-generic type.

1895 - Saccardo (1895) raised his sub-genus *Ophiochaeta* to generic rank. Again, no type species was designated but the following species were included in this order : *O.penicillus* (Schmidt ex Fr.) Sacc., *O.chaetophora* (Crouan) Sacc., *O.incompta* (Car.& de Not.) Sacc., *O.helminthospora* (Rehm) Sacc., *O.gracilis* (Niessl) Sacc., *O.barbata* (Pat.& Gaill.) Sacc. and *O.trichella* (Bomm.,Rouss. & Sacc.) Sacc. (Saccardo did not include author names or references to the basionyms, but referred to *Sylloge* 2, p.352 where author citations were given under *Ophiobolus* subgenus *Ophiochaeta*. This does not affect the validity of his *Ophiochaeta* names and he definitely indicated in 1895 that the epithets listed were to be used in *Ophiochaeta*; see Art.33, Stafleu *et al*.,1972). This list contained several species not included in sub-genus *Ophiochaeta* 1883, but also specifically excluded *Ophiobolus herpotrichus* and *O. pellitus* which were being investigated further. Saccardo here also reduced *Acanthophiobolus* Berlese (1892) to synonymy under *Ophiochaeta* (Sacc.) Sacc..

1897 - Sydow (1897, p.482), in an index entry, stated '*Ophiochaeta* Sacc. est *Ophiobolus* Riess'.

1899 - Berlese (1899) accepted Saccardo's (1895) concept of *Ophiochaeta*, including the reduction of *Acanthophiobolus* to synonymy (listed erroneously by Berlese as *Acanthostigma* but with the *Acanthophiobolus* reference). He gave brief descriptions of the seven species listed by Saccardo (1895) and included an eighth, *Ophiochaeta raciborskii* Penz. & Sacc. (1897). No generic type species was mentioned. Moreover, in contrast to his 1892 statement, he excluded *Ophiobolus herpotrichus* from *Ophiochaeta* with the words 'Peritheciis tomentosis sed non setis rigidis ornatis, *Ophiochaeta* adscribi non potest'.

1901 - Mussat (1901), in the *Synonymia*, listed *Ophiobolus chaetophorus*, *O.incomptus* and *O.penicillus* in *Ophiochaeta*, quoting the 1895 reference.

1907 - Höhnel (1907) listed the genus incorrectly as *Ophiochaeta* Berlese (1899) and reduced *Ophiosphaeria* Kirschstein (1907) to synonymy. He realised that Kirschstein's species *O.tenella* was identical with *Ophiochaeta chaetophora* (Crouan) Sacc. (see under *Acanthophiobolus*).

1921 - Weese (1921, p.115) regarded *Sphaeria penicillus* Schmidt ex Fr. (*Ophiochaeta penicillus* (Schmidt ex Fr.) Sacc.) as the type of the genus *Ophiochaeta*. (For further discussion of the epithet '*penicillus* Schmidt ex Fr.', see under *Sphaeria penicillus*).

1931 - Clements and Shear (1931) listed *Ophiochaeta herpotricha* (Fr.) Sacc. as the generic type. However, there is no evidence that Saccardo ever made this combination and indeed in 1895 he specifically excluded *Ophiobolus herpotrichus* from *Ophiochaeta*, as did Berlese (1899).

1936 - Kirschstein (1936) accepted Weese's (1921) concept of *Ophiochaeta* based on *Sphaeria penicillus* and disagreed with Höhnel's (1907) reduction of *Ophiosphaeria* Kirsch. to synonymy under *Ophiochaeta*.

1952 - Müller (1952) regarded *S.penicillus* as the generic type of *Ophiochaeta*, which he reduced to synonymy under *Ophiobolus* Riess. He listed it as *Ophiobolus penicillus* (Schmidt ex Fr.) Sacc..

1971 - Ainsworth (1971) listed *Ophiochaeta* (Sacc.) Sacc. = *Ophiobolus*, fide Müller and also listed both *Acanthophiobolus* Berlese and *Ophiosphaeria* Kirschst. as synonyms of *Ophiochaeta*.

1975 - von Arx and Müller (1975) regarded *Lasiosphaeria gracilis* Niessl as the type species of *Ophiochaeta*, which they listed in synonymy under *Acanthophiobolus* Berlese.

Saccardo's (1883) concept of the subgenus *Ophiochaeta* was of species with setose perithecia and he did not change that concept when he raised *Ophiochaeta* to generic rank in 1895. Berlese (1899) reinforced this with his statement of rejection of *Ophiobolus herpotrichus* from *Ophiochaeta*. Although Saccardo did not nominate a type species, three have been suggested by other workers.

(i) *Ophiobolus herpotrichus* (Fr.) Sacc. by Berlese (1892) for subgenus *Ophiochaeta*. This choice was later rejected (Saccardo, 1895; Berlese 1899) but was accepted by Clements and Shear (1931).

(ii) *Sphaeria penicillus* Schmidt ex Fr.by Weese (1921), and by Müller (1952).

(iii) *Lasiosphaeria gracilis* Niessl by von Arx and Müller, (1975).

Ophiobolus herpotrichus is not a suitable choice. It was rejected by Saccardo (1895) and also by Berlese (1899) who originally proposed it. It is not a setose species and is not in accord with Saccardo's concept. It is treated here under *Ophiosphaerella* (q.v.). *Sphaeria penicillus* is regarded at present as a confused name, on the basis of material studied so far and its use in the literature. It is not a suitable choice and further details are given under *Sphaeria penicillus* below. The third, and most recent, choice, *Lasiosphaeria gracilis*, is suitable. It is one of the species listed by Saccardo (1895) when he raised *Ophiochaeta* to generic rank and it is a setose species in accord with Saccardo's concept of *Ophiochaeta*. Based on *L.gracilis*, *Ophiochaeta* (Sacc.) Sacc. (1895) is a later name for fungi placed here under *Acanthophiobolus* Berlese (1892) (q.v.).

Several *Ophiochaeta* names are listed and some dispositions suggested. In earlier literature dealing with fungi with hairy ascocarps, the distinction between a sparse or dense covering of brown hyphae of indeterminate length (often associated with a brown mycelium on or in the substrate), and setae of determinate length, has not always been recognised. Berlese (1899), Weese (1921), Drechsler (1934) and Walker (1972) discussed this in connection with *Ophiochaeta* and some other genera. The former condition is found in *Sphaeria herpotricha* Fr. and species in many genera such as *Leptosphaeria*, *Ophiosphaerella*, *Ophiobolus* sens. lat., *Phaeosphaeria* and others. The latter condition is found amongst fungi placed here in *Acanthophiobolus* and in some other genera.

Ophiochaeta barbata (Pat.& Gaill.) Sacc. (1895) (listed by Berlese (1899) as '(Pat.) Berl.') - see under *Acanthotheciella* v. Höhn.

Ophiochaeta chaetophora (Crouan) Sacc. (1895) - a synonym of *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (q.v.).

Ophiochaeta cladii Cruchet (1923) - a probable synonym of *Acanthophiobolus helicosporus*; see discussion under that name.

Ophiochaeta gracilis (Niessl) Sacc. (1895) - a synonym of *Acanthophiobolus helicosporus* (q.v.).

Ophiochaeta graminis (Sacc.) Hara (1916, from Tanaka,1917) - this is *Gaeumannomyces graminis* var. *graminis* (q.v.).

Ophiochaeta helminthospora (Rehm) Sacc.(1895) - a synonym of *Acanthophiobolus helicosporus* (q.v.).

Ophiochaeta herpotricha (Fr.) Sacc. in Clements & Shear (1931) - no evidence that Saccardo made the combination attributed to him by Clements and Shear (1931) could be found. The species is placed here as *Ophiosphaerella herpotricha* (q.v.).

Ophiochaeta incompta (Car.& de Not.) Sacc. (1895)
    ≡ *Rhaphiodophora incompta* Car.& de Not. (1867, original not seen, from Saccardo, 1895; type not seen).

Berlese (1899) examined the type (on branch of *Ribes*, northern Italy) which he said was sterile, and repeated the original description. Perithecia were said to be densely hairy, carbonaceous, fragile, with a short neck, abundant asci with yellowish, filiform closely septate ascospores, and numerous filiform paraphyses. No measurements were given and the identity of this species is not known.

Ophiochaeta penicillus (Schmidt ex Fr.) Sacc. (1895) - for discussion, see under *Sphaeria penicillus*.

Ophiochaeta raciborskii Penz. & Sacc. (1897) - now placed as *Lasiosphaeria raciborskii* (Penz.& Sacc.) Carroll & Munk; for full description and discussion, see Carroll and Munk (1964).

Ophiochaeta trichella (Bomm.,Rouss.& Sacc.) Sacc. (1895), type not seen (listed by Berlese, 1899 as '(Bomm.,Rouss. & Sacc.) Berl.').

≡ *Ophiobolus trichellus* Bomm.,Rouss.& Sacc. in Sacc. (1891).

According to Berlese (1899), the type (on *Ammophila* (as *Psamma*) *arenaria* leaves, Belgium) is sterile. The original description indicates small perithecia 60-100 µm diam crowned with simple acuminate brown flexuous hairs 24-33 x 4 µm and containing oblong-clavate sub-sessile asci 45-66 x 10-15 µm with eight hyaline filiform 11-15 septate ascospores 60 x 3 µm and indistinct paraphyses. The identity of this species is not known.

OPHIOSPHAERELLA

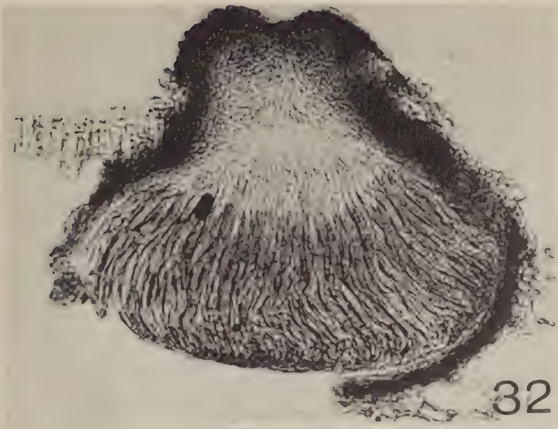
Ophiosphaerella Spegazzini, *Anal.Mus.Nac.Buenos Aires* **19** (Ser.3,**12**), 401-402, 1909.

Type sp. *O. graminicola* Speg.

The genus *Ophiosphaerella* was not defined separately by Spegazzini (1909) but a description and illustration of the single new species *O.graminicola* were given. This provided a *descriptio generico-specifica* and the genus is validly published (Art.42, Stafleu *et al*., 1972). Petrak and Sydow (1936) examined portion of the original collection, described it in detail, transferred the type species as *Ophiobolus graminicola* (Speg.) Petrak & Syd. and reduced *Ophiosphaerella* Speg. to synonymy under *Ophiobolus*. This opinion was followed by Ainsworth (1971). The genus was not listed by von Arx and Müller (1975).

Examination of the holotype has confirmed that *Ophiosphaerella* is a Pleosporaceous genus, but it differs from *Ophiobolus* Riess sens.str.. It is a scolecospored fungus, closely related to, and congeneric with, *Phaeosphaeria herpotricha*. The genus *Phaeosphaeria* Miyake (1909) was described in the same year as *Ophiosphaerella*. Its type species, *P.oryzae* Miyake, has been lectotypified by Eriksson (1967) and many species studied in detail by Holm (1957), Eriksson (1967) and Hedjaroude (1969). With the exception of the scolecospored *P.herpotricha*, all species have either phragmospores (mainly) or dictyospores (*P. vagans* (Niessl) O.Erikss.), usually with either a complete

Figures 32-36. *Ophiosphaerella* spp. 32. *O.graminicola*, section ascocarp, x 183, from holotype LPS 858 (slide as DAR 34112). 33. *O.herpotricha*, section young ascocarp, x 183, from holotype in UPS (slide DAR 34127). 34-36. *O. erikssonii* from holotype, DAR 31924. 34. Young asci, x 733. 35. Ascus with ascospores, x 733. 36. Ascospore, x 733.



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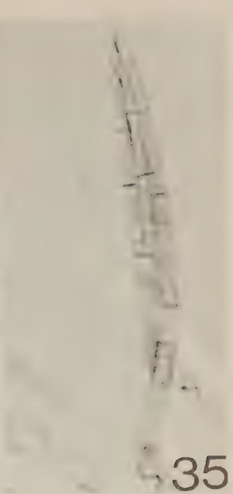

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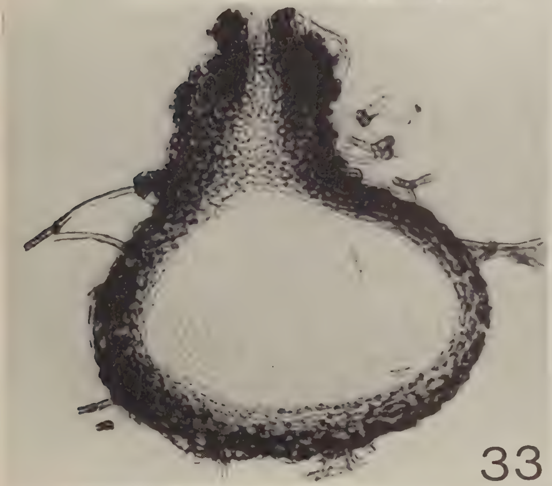

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or partial gelatinous sheath and one (occasionally two) swollen cells. Whilst Holm (1957) placed *P.herpotricha* in *Phaeosphaeria*, he realised that it was not typical of this genus (L. Holm, *in litt*.) and Eriksson (1967) concluded that it should be in a different genus.

It is proposed that *P.herpotricha* be removed from *Phaeosphaeria* and placed in *Ophiosphaerella* Speg., where several other similar brown scolecospored Pleosporaceous fungi on Gramineae and Cyperaceae can be brought together. Removal of the scolecospored *P.herpotricha* leaves the species with sheathed phragmospores and dictyospores in *Phaeosphaeria*, forming a more homogenous group. The type species of *Ophiosphaerella* is described and several new *Ophiosphaerella* names considered.

Ophiosphaerella graminicola Speg., *Anal.Mus.Nac.Buenos Aires* *19*, (Ser.3, *12*), 401-402, 1909 (type in LPS !)
≡ *Ophiobolus graminicola* (Speg.) Petrak & Sydow, *Ann. Myc*. *34*, 13-14, 1936 (as '*graminicolus* ').

Ascocarps (Fig.32) embedded in leaf sheaths, dark brown to black, 300-350 µm diam with a centrally placed short wide neck, to 100 µm high and 100-120 µm wide; wall 20-25 µm thick at base and sides, 30-35 µm above at junction with neck (in area where penetration of leaf sheath occurs), of 6-10 layers of brown radially flattened cells, inner layers paler to hyaline, 6-10 x 3-4 µm, with unthickened or only slightly thickened walls, outer layer in surface view a textura angularis of cells 6-12 µm diam; neck canal 20-30 µm wide, with hyaline periphyses. *Asci* long cylindrical, narrower at foot-like base, bitunicate, 120-135 x 7-10 µm, borne in a dense basal layer, eight-spored, apical apparatus not observed. *Ascospores* (Fig.39) filiform, brown, 110-140 x (1.5) 2-2.5 µm, with 12-20 transverse septa arranged 7-10 µm apart, lying parallel or more commonly partly spirally twisted near their middle. *Pseudoparaphyses* abundant, hyaline, septate, very thin, 1-1.5 µm wide. *Conidial state* not known.

Illustrations: Spegazzini (1909, habit, section ascocarps, asci, ascospores).

Specimen examined: on leaf sheath of *Leptochloa virgata* Wight ex Steud., Tucuman, Argentina, 14.iv.1906, C. Spegazzini, LPS 858, HOLOTYPE (slides as DAR 34112).

Ophiosphaerella Speg. is distinguished from *Phaeosphaeria* Miyake by its scolecospores, which have no swollen cells or gelatinous sheath or appendages, and from *Ophiobolus* Riess by ascospores which do not have central swollen cells or separate into part spores.

Other *Ophiosphaerella* names

The species grouped here occur on Gramineae or Cyperaceae and have ascocarps with relatively thin walls (often 20-40 µm), composed of thin walled radially flattened cells, and long cylindrical bitunicate asci, with eight pale brown filiform multiseptate ascospores, usually in the range 100-200 x 1.5-3 µm. With the exception of *Phaeosphaeria herpotricha*, most are known only from the type specimen or relatively few other collections. They may represent one variable widespread species on a large range of host genera or a complex of closely related but separate species with narrower host and geographic ranges. More collections, pure culture work, study of conidial states and intensive work on their taxonomy and pathology are needed to clarify these matters.

For the present, the species are kept separate. One, O.erikssonii, is described as new; the remainder are transfers to Ophiosphaerella. Bringing them together in the one genus indicates their similarity; keeping them separate for the present avoids possibly distinct species being buried in synonymy without sufficient work. The earliest epithet for these fungi comes from Sphaeria herpotricha Fr. and they may be regarded as members of a complex of scolecospored Pleosporaceous fungi on Gramineae and Cyperaceae, whose best known member is Ophiosphaerella herpotricha (Fr.) Walker.

Ophiosphaerella erikssonii sp.nov. (etym.erikssonii, Dr. Ove Eriksson, Umeå, studens Pleosporalium)

Pseudothecia (Fig.37) sparsa, in vaginis foliorum, corpus immersum fuscum, globosum vel subglobosum 200 µm diam, collum centrale breve erumpens; paries pseudothecii 10-20 µm crassus, facile fractus, ex 5-7 stratis cellularum fuscarum complanatarum 5-10 x 3-5 µm constatus. Asci (Figs.34 and 35) elongati clavati vel cylindrici, bitunicati, ad apicem rotundati, basin versus attenuati et unguliformes, 80-100 x 9-12 µm, octospori. Ascosporae (Figs.36 and 39) biseriatae, pallide brunneae, filiformes, in asco parallelae vel parum tortiles, cum extremis rotundatis, rectae vel plerumque arcuatae, (60) 80-95 x 2-2.5 µm, supra medium latissimae, (3) 5-7 septatae. Pseudoparaphyses numerosae, hyalinae, septatae, 1-2 µm latae. Hyphae affixae ad parietem pseudothecii sparsae, pallide brunneae, septatae, 3-4 µm latae. Conidia ignota.

HOLOTYPUS: in vaginis foliorum Calamagrostidis neglectae, ad littus, in insula petrosa, ad 1 km. S.W. phari, Vannskaren, parochia Nysatra, Vasterbotten, Suecica, 14.viii.1964. O. Eriksson 2419d, DAR 31924 (specimen et laminae vitreae).

ISOTYPUS: in UPS

Pseudothecia (Fig.37) sparse, in leaf sheaths, embedded body dark brown, globose to subglobose 200 µm diam, with a short central erumpent neck; wall of pseudothecium 10-20 µm thick, easily broken, composed of 5-7 layers of brown flattened cells 5-10 x 3-5 µm. Asci (Figs.34 and 35) elongated clavate to cylindrical, bitunicate, rounded apex, narrowed towards the foot-shaped base, 80-100 x 9-12 µm, eight-spored. Ascospores (Figs.36 and 39) biseriate, pale brown filiform, lying parallel or slightly twisted in the ascus, ends rounded, straight or more usually slightly curved, (60) 80-95 x 2-2.5 µm, widest above the middle, (3) 5-7 septate. Pseudoparaphyses numerous, hyaline, septate, 1-2 µm wide. Hyphae joined to pseudothecial wall sparse, pale brown, septate, 3-4 µm wide. Conidia unknown.

HOLOTYPE: in leaf sheaths of Calamagrostis neglecta, on the shore of a

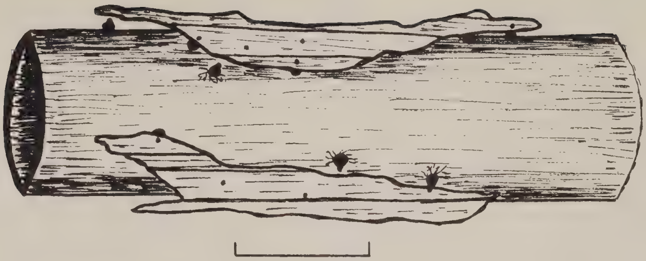


Figure 37. Ophiosphaerella eriksson ii, habit, from holotype, DAR 31924.

rocky islet, 1 km. S.W. of lighthouse, Vannskaren, Nysatra parish, Vasterbotten, Sweden, 14.viii.1964, O. Eriksson 2419d, DAR 31924 (specimen and microscope slides).

ISOTYPE: in UPS

O. erikssonii is known only from the one rather sparse collection mentioned briefly by Eriksson (1967) who commented on its superficial similarity to Gaeumannomyces graminis, especially in ascospore size and shape. It is a typical Ophiosphaerella with slightly curved ascospores, shorter than those of the other species considered here. Though known only from one collection, it is described as new to bring it to the notice of mycologists and plant pathologists working with take-all and other root, crown and lower stem diseases of Gramineae.

Ophiosphaerella herpotricha (Fr.) Walker comb. nov.

≡ Sphaeria herpotricha Fr., Syst. mycol. 2, 504, 1823 (type in UPS !)

≡ Rhaphidophora herpotricha (Fr.) Tul., Sel. Fung. Carpol. 2, 255, 1863.

≡ Rhaphidospora herpotricha (Fr.) Ces.& de Not., Comment. Soc. Cryptog. Italiae, fasc. IV, 233-234, 1863 (orig. not seen; from Tulasne and Tulasne, 1863).

≡ Rhaphidospora herpotricha (Fr.) Fckl., Symb. mycol. 125, 1870, (as '(Fr.) Tul. unter Rhaphidophora').

≡ Ophiobolus herpotrichus (Fr.) Sacc. in Roum. & Sacc., Rev. mycol. 3, 45, 1881.

≡ Ophiochaeta herpotricha (Fr.) Sacc. in Clements & Shear, The Genera of Fungi, 277, 1931.

≡ Phaeosphaeria herpotricha (Fr.) Holm, Symb. bot. Upsal. 14, 119, 1957.

= Ophiobolus zeae Saccas, Rev. Pathol. veg. Entomol. agric. Fr. 30, 183-186, 1951 (type in PC !).

= Ophiobolus medusae Ell.& Ev. f.bromi Brenckle, Fungi Dakotenses 536, 1923 (in NY !)

The following description was prepared from the type specimen of Sphaeria herpotricha Fr. in UPS:

Pseudothecia (Figs.33 and 38) on pieces of grass straw with leaf sheaths attached, dark brown, body globose to subglobose 300-400 µm diam seated on the stem surface with a short conical neck to 100 µm long, 80 µm wide near base but narrower above, erumpent through the covering leaf sheaths, joined to and surrounded by an abundant dark brown mycelium. Wall (Fig.33) of body of ascocarp 25-35 µm thick, of 6-8 layers of radially flattened cells 6-12 x 4-6 µm with brown unthickened or very slightly thickened walls, outer layers dark brown, inner paler to almost hyaline, outer layer in surface view forming a textura angularis of cells 6-12 µm diam; wall of neck to 30 µm thick, ostiolar canal 20 (25) µm diam, periphyses not seen but globose hyaline cells present in canal in young ascocarps. Asci bitunicate, long, narrowly elongated clavate, apex to 3-4 µm thick, base foot-shaped, 150-190 x 7-9 µm, widest about 20-30 µm below apex. Ascospores (Fig.39) eight per ascus, long, filiform, pale brown to brown in mass, pale brown singly, lying parallel or loosely twisted for part of their length, 12-16 septate with septa 10-14 µm apart, 140-180 x 2-2.5 (3) µm, apex rounded, base rounded and narrower, widest about 20 µm below apex, straight to curved or slightly sinuous. Pseudoparaphyses abundant, hyaline, septate, 2-3 µm wide, longer than the asci. Mycelium dark brown, attached to pseudothecia and giving them a hairy appearance and running over surface of stem between leaf sheaths, little mycelium seen on outer surface of leaf sheaths, composed of dark brown branching septate hyphae 3-7 µm wide, some with nodular swellings, both smooth and rough-walled hyphae present, roughening from fine echinulations to coarse tubercules, some hyphae with intercalary hyphopodia present, abundant penetration points on stem surface associated with mycelium.

This description agrees well with the concept of O. herpotricha in the literature (Müller, 1952; Holm, 1957; Shoemaker, 1976) and with several collections examined. In the type, some pseudothecia showed asci of variable maturity and possibly most of the ascospores examined were not fully mature (they were not readily freed from asci under pressure). In IMI 98564b on Axonopus africanus, a distinct nassé apical was seen in some asci. In some collections, ascospores to 200 µm long and with up to 20 septa have been seen. Sometimes, the pseudothecial neck is longer (to 200 µm) and the amount of surrounding mycelium also varies between collections.

The ascospores of O.herpotricha are usually twisted in the ascus. The degree of twist is usually only about one complete turn in the length of the ascus, and the twisting is often only for portion of their length (often the middle) leaving the remainder of the length untwisted. The twisting is never the dense spiralling seen in Acanthophibolus or described by Drechsler (1934) for Cochliobolus heterostrophus (Drechs.) Drechs. where several complete turns are present.

It is possible that several other species may belong here but study of the type collections is needed to decide this. Collections (not type) of Ophiobolus medusae Ell. & Ev. var. minor Ell.& Ev. (1890) and O. andropogonis Ell.& Ev. (1894), both described from Vetiveria zizanioides (as Andropogon muricatus), and O. oryzae Miyake (1909), have been studied and were Ophiosphaerella herpotricha. Shoemaker (1976) listed O. medusae var. minor as a synonym, but did not study the type. Sawada (1959) listed O.oryzae as a synonym of Ophiosphaerella herpotricha but it is not known whether he saw the type or not. A discussion of the confusion surrounding the names O.medusae var. minor and O. andropogonis is given under the latter name.

Saccardo (1883) described what he thought was the pycnidial state of O.herpotrichus as Hendersonia herpotricha Sacc.. The yellowish-brown cylindrical conidia measured 36 x 6 µm and had 8 septa. Webster and Hudson (1957) showed the connection in culture between O.herpotricha and a pycnidial state with 5-6 septate cylindrical conidia 69-116 x 3-4 µm with a truncate base and tapering to a thin bristle-like apex. They tentatively placed it as a species of Urohendersoniella Petrak but it is better considered as a species of Scolecosporiella Petrak (Sutton, 1977). A similar conidial state has been found on some collections in association with O.herpotricha pseudothecia. Further work on the taxonomy and

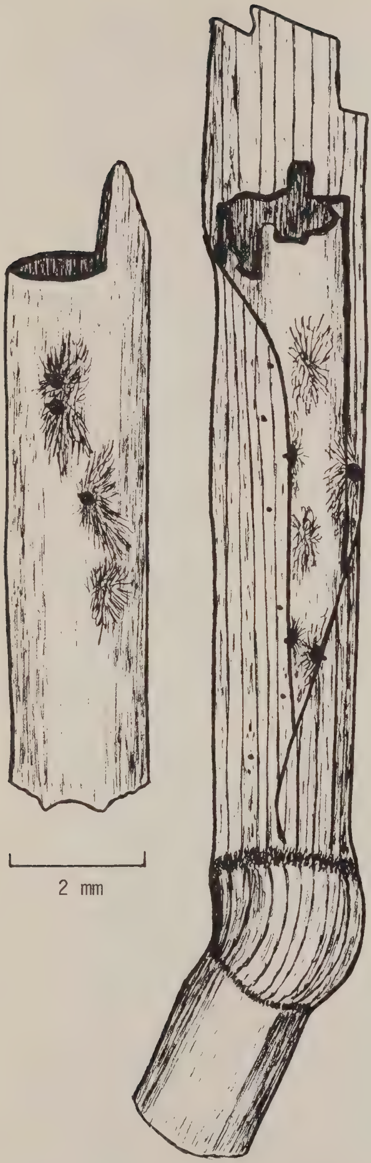


Figure 38. Ophiosphaerella herpotricha, habit, from holotype in UPS.

nomenclature of the pycnidial state is in progress.

Illustrations: Müller (1952, ascospore); Shoemaker (1976, ascospores and ascus).

Specimens examined: on '*Axonopus africanus*' (exact identity not known; grass name not traced at Herb. NSW), near Kuida, Guinea, 12.xi.1962, F. Krantz 312, IMI 98564b as *O.zeae* Saccas (slides as DAR 33291). On *Bromus inermis* Leysser, Kulm, North Dakota, U.S.A., 15.vi.1923, J.F. Brenckle, *F. Dakotenses* 536, NY as *O.medusae* f.*bromi*, both pseudothecia and *Scolecosporiella* pycnidia present (slides as DAR 34113); Uppsala, Uppland, Sweden, 9.vii.1946, S. Lundell, dup. ex UPS as DAR 14323. On *Echinochloa crus-galli* (L.) Beauv. (as *Panicum*), U.S.A., 24.ii.1887, A.B. Langlois 1038, BPI as *Ophiobolus* sp. (slide as DAR 33692). On *Oryza sativa*, sheath rot, Fiji, 28.i.1966, K.M. Graham, DAOM 113212 formerly as *Ophiobolus oryzae* Miyake (slides as DAR 33305). On *Vetiveria zizanioides* (as *Andropogon muricatus*), St. Martinsville, Louisiana, U.S.A., Jan.1890, A.B. Langlois 2209 (partly), NY as *Ophiobolus andropogonis* Ell.& Ev., not type (slides as DAR 33737); same, 5.iv.1892, A.B. Langlois 2343, DAOM 128729, formerly as *Ophiobolus medusae* var. *minor* Ell.& Ev., not type (slides as DAR 33306). On *Zea mays*, near Boukoko, Oubangui-Chari, Central African Republic, 23.xi.1951, A.M. Saccas, PC, TYPE of *Ophiobolus zeae* Saccas (slides as DAR 33270); same, August 1958, A.M. Saccas, DAOM 59724. On undetermined Gramineae, Sweden, no date or collector, *Scler.suec.exs.* n. 52, UPS, HOLOTYPE of *Sphaeria herpotricha* Fr. (slides as DAR 34127); Krieg. *F. Sax*. 1574, slide A3786 in FH as *Leptosporopsis herpotrichus*, no collection details given.

Three collections with immature ascospores which may be *O.herpotricha* are: on *Chloris gayana* Kunth, Gainesville, Florida, U.S.A., August 1947, G.E. Ritchey, BPI as *Ophiobolus* (slides as DAR 33687). On *Chrysopogon* sp., Kharian, Pakistan, 21.vii.1964, S. Ahmad 18086, IMI 136978a as *Ophiobolus* sp. (slides as DAR 33293). On *Oryza sativa* (as Gramineae), Liberia, 1.ix.1940, S. Lennox, BPI as *Ophiobolus* (slides as DAR 33688).

Ophiosphaerella leptosperma (Speg.) Walker comb. nov.

≡ *Rhaphidophora leptosperma* Speg., *Anal.Soc.Cient.Argent.* 10, 18, 1880 (type in LPS !)

≡ *Ophiobolus leptospermus* (Speg.) Sacc., *Syll.fung.*2, 350, 1883.

≡ *Rhaphidospora leptosperma* (Speg.) Cke., *Grev.*18 (85), 16, 1889 (as '*Raphidospora leptosperma* Cke.').

Pseudothecia embedded in culm tissue, dark brown to black, up to 400-500 µm diam, with central erumpent neck, most broken off flush with host tissue; wall hard, 30-50 µm thick, of 10-15 (20) layers of radially flattened brown cells with unthickened walls. *Asci* long cylindrical to elongated clavate, 200-210 x 10-12 µm, narrower near the foot-like base, bitunicate, eight-spored. *Ascospores* (Fig. 39) long filiform, pale brown in mass, pale yellowish brown singly, arranged parallel or somewhat spirally twisted in the ascus, 150-200 x 2-2.5 µm, multiseptate. *Paraphyses* abundant, hyaline, septate, 1.5-2 µm wide. *Conidia* not known.

Specimen examined: on dead culms of *Scirpus* sp., Recoleta, Buenos

Aires, Rio de la Plata, Argentina, April or May, 1880, C. Spegazzini, LPS 2353, HOLOTYPE (slides as DAR 34115).

Many fruiting bodies are broken and empty and others are packed with hyaline hyphae. The date on the original hand-written inner packet is '5/5 1880'; on the outer packet it reads 'iv-1880'. The other information is the same except that the host was originally tentatively identified as 'in culmis ? Junci'.

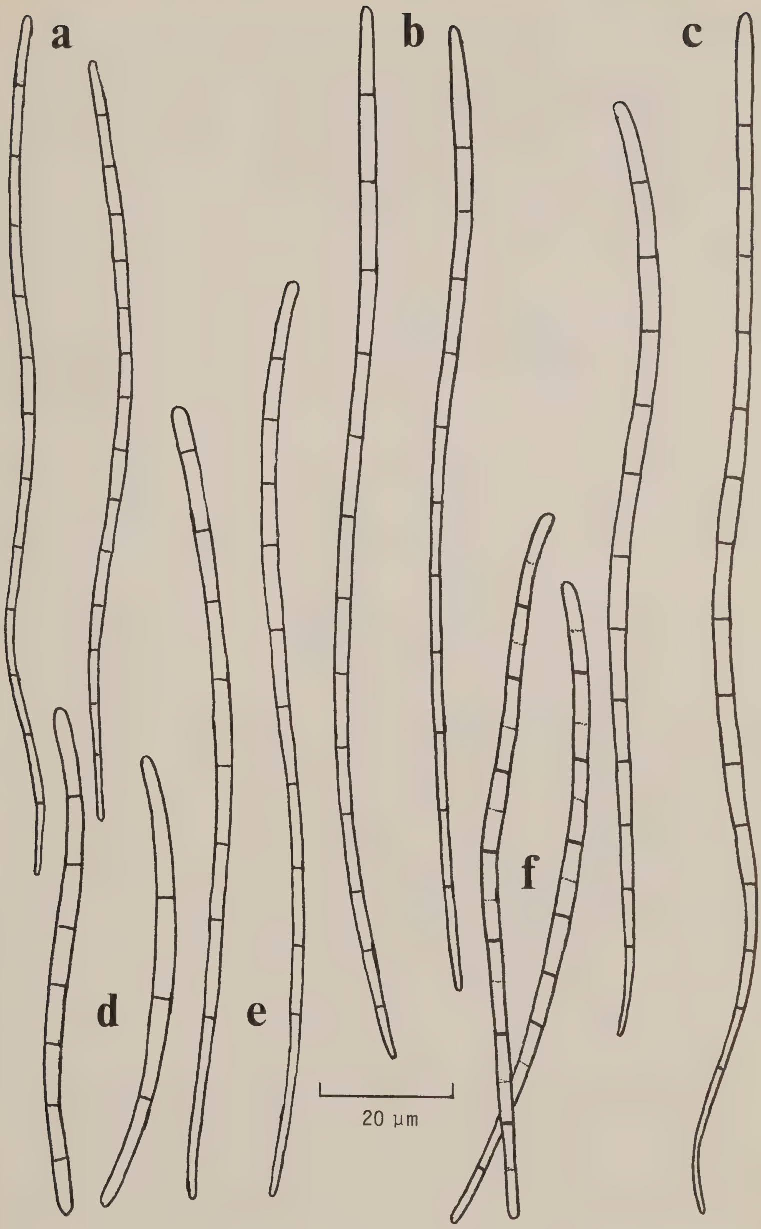
In characters of ascocarps, asci and ascospores, O. leptosperma falls within the wide range of variation found in the literature for O.herpotricha, but its pseudothecia are somewhat larger and firmer than those in many collections under that name and much less free mycelium is present. As far as can be seen, it is known only from the type specimen. Until Ophiosphaerella spp. are better known, and the relationship between those on Gramineae and Cyperaceae clarified, it is retained as a separate species.

Ophiosphaerella stipae (Hansford) Walker comb.nov.

≡ Linocarpon stipae Hansf.,Proc.Linn.Soc. N.S.W. 79, 121-122, 1954 (type in ADW !)

Pseudothecia (Fig.40) in blackened leaf sheaths associated with an abundant brown superficial mycelium, body embedded in sheath tissue, globose to subglobose, 350-500 µm diam, with central neck erumpent through several layers of leaf sheath, neck straight to slightly curved, narrowly conical, 300-350 µm long, 100-175 µm wide, with 2-3 thickened circular bulges (representing pressure ridges between successive layers of leaf sheath, see Walker and Smith, 1972); wall of body dark brown to almost black, 25-30 µm thick, of 5-10 layers of brown thin walled radially flattened cells 9-11 x 3-4 µm, outer layers joined to brown hyphae; wall of neck generally to 50 µm thick, but much thicker (from 75-125 µm) at bulges; neck canal 50-70 µm wide, densely lined with fine hyaline, slightly upwardly-pointing periphyses, up to 30 µm long, 1-1.5 µm wide and with 1-2 indistinct septa. Asci (Figs.40 and 43) bitunicate, long cylindrical or narrowly clavate, 120-180 x 10-13 µm, apex rounded 6-8 µm thick with thin internal canal, area up to 40 µm long towards bottom free of spores, base foot-like, eight-spored. Ascospores (Figs.39,40 and 44) filiform, brown in mass, pale yellowish brown singly, 90-120 (130) x 2.5-3 µm, narrowing slightly towards the base, (7) 13-15 septate, often very slightly constricted at the central (usually the eighth) septum, straight or more often slightly curved to

Figure 39. Ophiosphaerella spp., pairs of ascospores.
a. O. graminicola, from holotype, LPS 858 (slide DAR 34112);
b. O. herpotricha, from holotype, in UPS (slide DAR 34127);
c. O. leptosperma, from holotype, LPS 2353 (slide DAR 34115);
d. O. erikssonii, from holotype, DAR 31924; e. O. williamsii, from holotype, ADW 3542 (slide DAR 31931); f. O. stipae, from holotype, ADW 3488 (slide DAR 31930)


a
b
c
d
e
f
20 µm

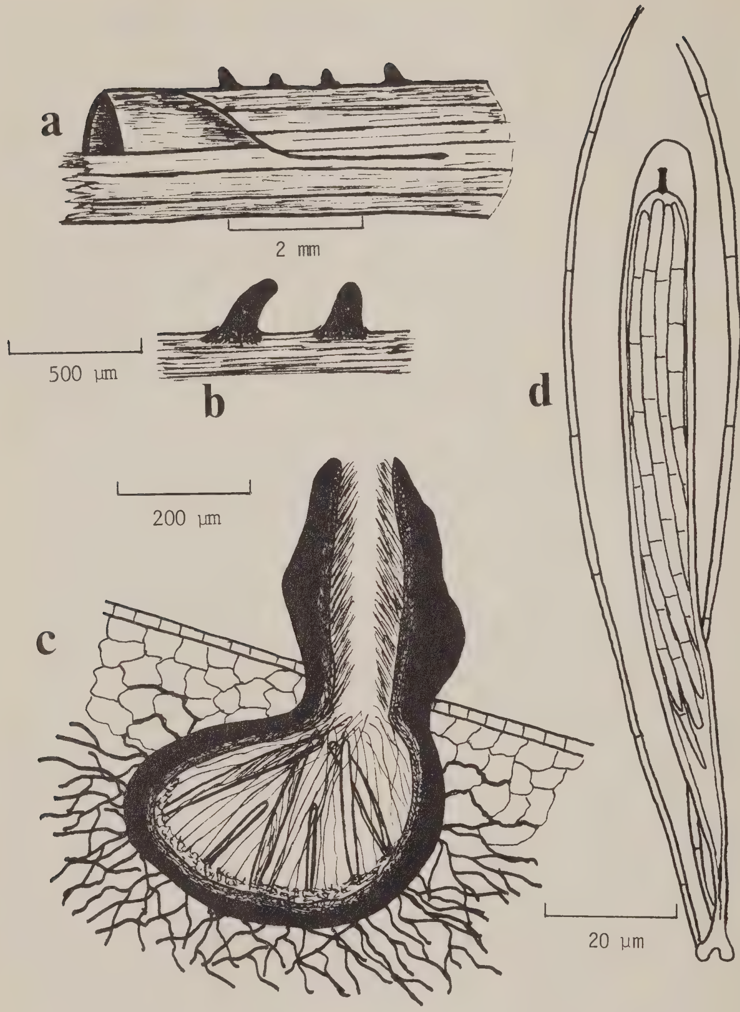

a
2 mm
500 µm
b
d
200 µm
c
20 µm

Figure 40. Ophiosphaerella stipae, from holotype, ADW 3488 (slide DAR 31930); a. habit; b. protruding necks of ascocarps; c. section ascocarp; d. ascus, ascospores and pseudoparaphyses.

sinuate, lying parallel in the ascus. *Pseudoparaphyses* (Fig. 40) abundant, hyaline, sparingly septate, longer than the asci, 1.5-2 µm wide. *Hyphae* forming an abundant mycelium on and between leaf sheaths and loosely binding them and soil particles together, attached to outside of pseudothecia and forming a dense weft around their base, individual hyphae brown, septate, 2.5-3.5 µm wide, with finely roughened walls, penetrating host cells either by slightly swollen hyphal tips or by short lateral swollen hyphopodial branches 5-8 x 5-6 µm each with a minute clear dot representing the point of host penetration. *Conidia* not known.

Specimen examined: on dead culm of *Stipa* sp., Meningie, South Australia, 24.vii.1953, L.D. Williams, ADW 3488, HOLOTYPE (slides as DAR 31930).

Hansford (1954) described this and the closely related *O. williamsii* (see below) in *Linocarpon*. Their type specimens show clearly their Pleosporaceous nature and they fit readily into *Ophiosphaerella* as defined here. *O. stipae* causes considerable blackening of infected host tissue and could be parasitic. The lateral infection branches with the minute clear penetration dot closely resemble the simple hyphopodia of *Gaeumannomyces graminis* and mentioned elsewhere (Walker and Smith, 1972) for *Leptosphaeria korrae* and *L. narmari*. However, the pathogenic capabilities of most species placed here in *Ophiosphaerella* are not known (see Walker, 1980).

Ophiosphaerella williamsii (Hansford) Walker comb.nov.

≡ *Linocarpon williamsii* Hansf., *Proc.Linn.Soc. N.S.W.* *79*, 122, 1954 (type in ADW !)

Pseudothecia (Fig.41) in leaf sheaths and culms, associated with sparse brown mycelium, body embedded in sheath or in harder culm tissue, globose to subglobose to broadly conical, often with flattened base, 200-350 µm diam with central erumpent neck 100-150 µm long, 50-90 µm wide; wall of body dark brown to almost black, 25-35 µm thick, of 5-10 layers of brown thin-walled radially flattened cells 9-12 x 3-5 µm, outer layers joined to superficial brown hyphae; wall of neck 20-25 µm thick, ostiolar canal 35-40 µm diam, sparsely lined with relatively coarse, hyaline slightly upwardly pointing periphyses, to 30 µm long, 2 µm wide, distinctly 1-2 septate. *Asci* (Fig.42) bitunicate, long cylindrical to narrowly clavate, 140-180 x 9-12 µm, apex rounded with thin internal canal, foot shaped base, eight-spored. *Ascospores* (Figs.39 and 42) filiform, brown in mass, pale yellowish brown singly, 120-150 x 2 (2.5) µm, 5-12 septate, septa 12-15 µm apart, ends often non-septate in immature spores, straight or slightly curved, lying parallel or more often spirally coiled for part of their length (often in the middle half). *Pseudoparaphyses* abundant, hyaline, indistinctly septate, 1.5-2 (2.5) µm wide and much longer than the asci. *Hyphae* on inside of leaf sheaths and on surface of culm, brown, septate, branched, 2.5-4 µm wide with finely roughened walls, penetrating cell walls as described for *O. stipae*.

Specimen examined: on dead culm and leaf sheaths of undetermined grass, Meningie, South Australia, July 1953, L.D. Williams, ADW 3542, HOLOTYPE (slides as DAR 31931).

O. williamsii and *O. stipae* are very similar. They differ in the smaller ascocarps of *O. williamsii*, which has longer, thinner ascospores (l : b about 60 : 1) than *O.stipae* (l : b about 36-40 : 1) and in the pattern of spore septation. In *O. stipae* it appears to be a fairly regular 1-3-7-15 development (with occasionally a few more or less giving spores with 13 or 17 septa) whereas in *O. williamsii* the pattern is much less clear but seems to be 1-3-5-7-9-11, with the central septum developing first and later septa developing in pairs, one on either side of the central septum and progressively further away. As noted above, the ends of immature ascospores in *O.williamsii* are often non-septate and this could result from such a developmental pattern. The ascospores in both species generally have fewer septa than those of *O. herpotricha.*

Other possible *Ophiosphaerella* spp.

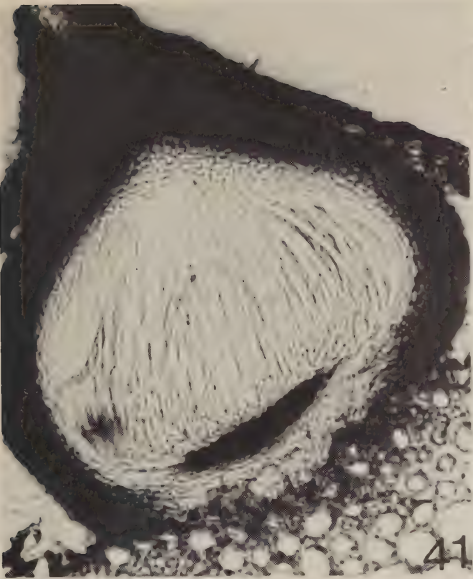
From the descriptions, it is possible that *Ophiobolus junci* Miller and Burton (1942) and *O. stipae* Doidge (1941) are species of *Ophiosphaerella*. Study of the type of *O. junci* is required; for comment on *O.stipae*, see under *Ophiobolus*. If *O.stipae* is found to be an *Ophiosphaerella*, a new name will be needed as the combination *Ophiosphaerella stipae* has already been used (see above).

OPHIOSPHAERIA

Ophiosphaeria Kirschstein, *Verh.Bot.vereins Prov.Brandenburg 48* (1906), 47-48, 1907.
Type sp. *O. tenella* Kirschst.

Study of the types has shown that *Ophiosphaeria* Kirschst. (1907) is not different from *Acanthophiobolus* Berlese (1892) and it is listed as a synonym of the latter genus (q.v.). Ainsworth (1971), following Höhnel (1907), considered *Ophiosphaeria* a synonym of *Ophiochaeta* (Sacc.) Sacc. Details of the status of these genera will be found under *Acanthophiobolus* and *Ophiochaeta*.

Figures 41-47. 41 and 42. *Ophiosphaerella williamsii*, from holotype, ADW 3542 (slide DAR 31931). 41. Section ascocarp, x 183. 42. Young asci with ascospores, x 733. 43 and 44. *O. stipae*, from holotype, ADW 3488 (slide DAR 31930), ascus with ascospores, and single ascospore, x 733. 45-47. *Sphaerulina antarctica*, from holotype, LPS 883 (slide DAR 33289). 45. Section ascocarp, slightly oblique, x 733. 46 and 47. Asci with ascospores, x 733.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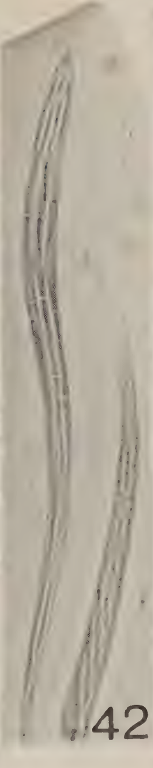
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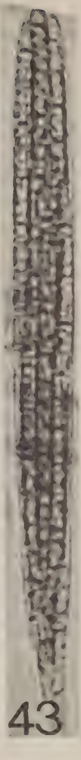
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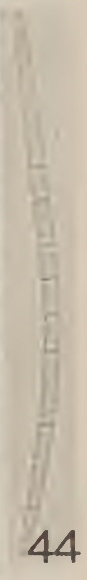
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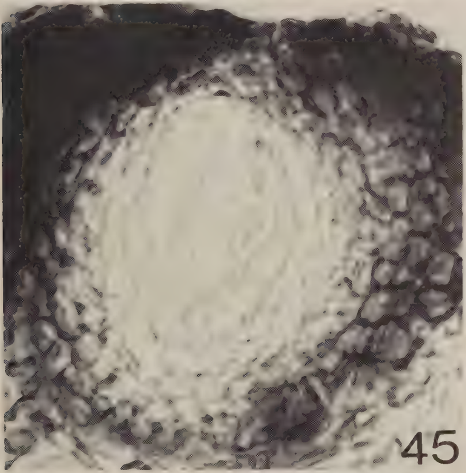
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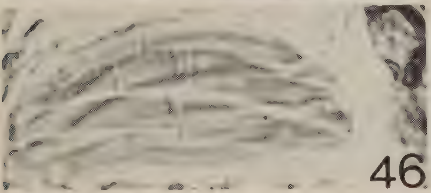
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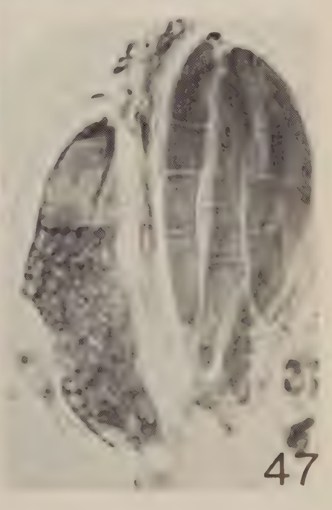
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OPHIOTRICHIA

Ophiotrichia Berlese, *Icon*.*fung*.*1*, 105, Jan. 1893 (not validly published; based on *Acanthostigma helminthosporum* (Rehm) Sacc., 1883, basionym *Leptospora helminthospora* Rehm, 1882).

In discussing several species he excluded from *Acanthostigma* de Not., Berlese (1893) suggested the new generic name *Ophiotrichia*, based on *Acanthostigma helminthosporum* (Rehm) Sacc. (1883), and characterised by filiform ascospores. In Volume 2 of his *Icones*, dealing with scolecospored species and published in parts from 1895 to 1900 (Stafleu and Cowan, 1976), he did not take up the name but, following Saccardo (1895), included A. *helminthosporum* in the genus *Ophiochaeta* (Sacc.) Sacc. (q.v.) as *O.helminthospora*. Moreover, almost at the same time, he formally and fully described the new genus *Acanthophiobolus* Berlese (1892) with *Leptospora* (as '*Lasiosphaeria*') *helminthospora* Rehm as the type species. The name *Ophiotrichia* was not taken up by Berlese, Saccardo or any other author. Weese (1921) listed it (as '*Ophiotricha*') as a synonym of *Acanthophiobolus* and Kirschstein (1936) regarded it as a 'nackter name' (nomen nudum). It was not listed by Ainsworth (1971).

The name *Ophiotrichia* Berlese (1893) should be considered as not validly published under both Articles 34 and 41 of the International Code of Botanical Nomenclature (Stafleu *et al*., 1972). After its first mention, it was not accepted by the author in the same publication nor by any later author. No suitable description or diagnosis was given and no reference made to a previously published description of it as a genus or subdivision of a genus. The name is listed here as a synonym (not validly published) of *Acanthophiobolus* (q.v.).

PHAEOSPHAERIA

Phaeosphaeria Miyake, *Bot*.*Mag*. (*Tokyo*) *23* (266), 93-94, 1909 (also in *J*.*Coll*.*Agric*.*Univ*.*Tokyo* *2*(4), 246-247, 1910).

Type sp. *P*.*oryzae* Miyake (for lectotypification, see Eriksson, 1967).

Phaeosphaeria spp. have been studied and described in detail by Holm (1957), Eriksson (1967) and Hedjaroude (1969). It is a Pleosporaceous genus of mainly graminicolous species with phragmospores or occasionally dictyospores, which have 1-2 swollen cells and a complete or partial gelatinous sheath or appendages. The only scolecospored species, *P*.*herpotricha* (Fr.) Holm, has long been regarded as an atypical *Phaeosphaeria* (Eriksson 1967; L. Holm, *in litt*.) and is removed here to *Ophiosphaerella* (q.v.).

PHIALOPHORA

Phialophora Medlar, Mycologia 7, 200-203, 1915.
Type sp. P.verrucosa Medlar (type not studied)

The Phialophora isolates considered here are some found in recent years associated with roots of Gramineae and include the conidial states of Gaeumannomyces spp.. Much of the literature on these fungi has centered around the name P. radicicola Cain (1952) which has been used in several different senses (Wong and Walker, 1975; Walker, 1980) and has become a source of confusion in the cereal take-all literature. It is known now that there is a complex of Phialophora-like fungi on roots of Gramineae (Scott, 1970; Walker, 1972; Deacon, 1973, 1974a,b; Sivasithamparam, 1975; Wong and Walker, 1975; Walker, 1980), including species such as P.mutabilis (Beyma) Schol-Schwarz, P.verrucosa Medlar and others (Sivasithamparam, 1975) which do not fall into the 'P.radicicola'complex. These species will not be considered here.

The isolates placed previously by various authors as P. radicicola seem to represent several closely related taxa, distinguishable only by a range of characters. A detailed knowledge of how many taxa are present, their range of variation and the reliability of differences between them can be obtained only after more intensive work on a wide range of isolates from many cereal and grass hosts in different countries. Isolates studied by the present author so far can be placed into four groups which are listed in Table 1 with the characters distinguishing them. In these groups, some characters seem to be correlated e.g. the only isolates studied which produce slightly lobed hyphopodia are also those that have the slowest growth rate (4-6 mm/24 hrs at their optimum temperature) and do not produce strongly curved non-germinating phialospores.

Undoubtedly, isolates will be found which will not fit into the four groups considered here or the groups themselves may be split up on the basis of other characters not yet considered. Hornby, Henden and den Toom (1979) isolated a Phialophora sp. from dark lesions on roots of wheat plants in a bioassay of soil at Woburn, England. This isolate was said to have germinating conidia similar to those of P.graminicola (see below) but had a faster growth rate, although not as fast as Gaeumannomyces graminis var. tritici or Phialophora sp. (lobed hyphopodia). It is felt that formal description and naming of isolates such as this would be premature and lead to an undue proliferation of names. For the present, isolates would be best referred to as Phialophora sp. with an accession number and their distinguishing characteristics listed. This would allow workers to compare isolates but no taxonomic or nomenclatural complications would have been introduced into a situation where limits of taxa are not yet known. Lodging of specimens and isolates in herbaria and culture collections would also ensure the availability of such isolates for taxonomic work.

In this section, Phialophora radicicola (group 1) is considered on the basis of its type specimen and two living cultures said to be the original isolate. Groups 2 and 3, which have been placed by some workers as varieties of Cain's species, are described from several isolates. Isolates placed in group 4 are the conidial states of Gaeumannomyces graminis var. avenae and var. tritici. These have been described elsewhere (Walker, 1980) and details of specimens and cultures studied are given under Gaeumannomyces. They will not be considered further here.

Group 1. The only member of this group is Phialophora radicicola Cain sens. str.

Phialophora radicicola Cain, Canad.J.Bot.30, 340-342,1952)
(type in TRTC !; living type culture in CBS !)

Cain (1952) described P.radicicola from a culture isolated from roots of Zea mays by W.E. McKeen at Chatham, Kent County, Ontario, Canada in the summer of 1950. At the same time, McKeen (1952) also found it in soil near Ridgetown, and studied its development on and in corn roots. As far as can be seen, there have been no subsequent records of this fungus in Canada. All material under the name P. radicicola in the University of Toronto Herbarium (TRTC) has been examined as well as a subculture from the living type culture in CBS and one from a culture of the original isolate from Professor W. E. McKeen.

The material in TRTC consists of two sheets, bearing six packets, all numbered TRTC 23660, containing dried agar cultures, thirteen microscope slides prepared from cultures and four sheets of pencil and ink drawings. One packet is marked TYPE and another Part of Type. All contain the same fungus which agrees with the description given by Cain (1952). The following description was prepared from this collection.

Dried cultures dark grey to black, some with abundant dense, fluffy greyish brown (two cultures) or pale grey (one culture) aerial mycelium, others with very sparse short aerial mycelium close to agar surface. Sclerotia numerous, black outside, black to pale grey inside, 0.75-1 mm diam, embedded in agar or produced on agar surface and then often completely or partly surrounded by dense aerial mycelium; sclerotia composed of thin walled pale brown to (more rarely) almost hyaline subglobose to oval cells 12-20 x 8-14 µm, a few as large as 28 x 16-18 µm, forming a pseudoparenchyma, outer layer with darker, thicker cell walls and dark brown septate hyphae, 2.5-3.5 µm wide growing over the surface. Hyphae very variable, from hyaline, thin, 1-3 µm wide to brown and 5-7 µm wide, septate, also moniliform hyphae of chains of brown, oval to globose cells 10-20 x 8-12 µm present, pore between adjacent cells readily seen, some similar single terminal or intercalary cells on other hyphae. Conidiophores in aerial mycelium, brown to dark brown, 2-5 µm wide, of very variable length, some to 1 mm or more, others shorter, branched above, branches ending in a dense head whose ultimate cells are phialides. *Phialides* hyaline to pale brown, long cylindrical but usually slightly wider at or below the middle, straight or more commonly slightly curved, 18-20 x 2-4 µm with an apical, often slightly flared collarette. *Phialospores* abundant, clustered over the heads of phialides, dried masses pale brown, individually hyaline, thin, from slightly to strongly curved to semicircular, 6-8 x 1-1.5 µm.

Several of the microscope slides have partially dried out and some are contaminated with secondary moulds and a white powdery substance. In two (nos.3 and 12) a number of small 4-5 x 2-3 µm hyaline narrowly oval to X and Y shaped spores, each with a clear central vacuole, was seen. They were abundant in slide 3, in which no other spores were present, and sparse in slide 12, where abundant curved phialospores produced from heads of phialides were also present. The source of these spores is not known. They were not seen in the other eleven slides, or in several slides prepared from the dried cultures or in the living cultures examined. They differ in size and shape from the conidia produced by other graminicolous *Phialophora* spp. and it is suspected that they are contaminants unconnected with *P. radicicola*.

The type culture from CBS, studied by Deacon (1974b) and Wong and Walker (1975), does not now show several of the characteristics described by Cain (1952) and McKeen (1952) and shown by the dried type specimen in TRTC. *Colonies* on PDA and other media are at first white to cream, later creamy brown, thin, with little aerial mycelium, and a growth rate of 6-7 mm/24 hrs at 20°C and 10-11 mm/24 hrs at 25°C. Pronounced 'curling back' of marginal hyphae (Walker, 1980) was seen in colonies at 20°C but was not nearly so pronounced at 25°C. *Phialospores* as seen in the dried type specimen were formed from single or clustered phialides borne on short hyaline hyphae. No brown conidiophores or dense heads of phialides as seen in the type specimen were produced. No germinating phialospores were produced. On wheat coleoptiles, infections occurred mainly from simple, thin, hyaline hyphae but a few small simple subglobose to oval hyphopodia up to 8-10 x 5 µm or to 6 µm diam were developed (Wong and Walker, 1975; Walker, 1980). No other infection structures were seen. Abundant lignituber development occurred in coleoptile cells infected from hyphae or hyphopodia.

An isolate labelled '*P.radicicola*' (33708), said to be the original isolate, was received from Professor W.E. McKeen. However, this did not agree either with the dried type material or with the living culture from CBS. It produced abundant germinating conidia, produced slightly lobed hyphopodia on wheat coleoptiles and had a growth rate of 4-6 mm/24 hrs at 25°C. No strongly curved non-germinating phialospores were produced. It is identical with *P.graminicola* (see below). Although this culture is said to be the original isolate, it does not agree with the type specimen and has no type status. Whether two organisms were isolated originally, only one of which was studied by Cain (1952) as a basis for his description of P. radicicola, cannot now be determined.

Neither the type specimen nor the now degenerate type culture in CBS nor the description given by Cain (1952) and McKeen (1952) show characters necessary for accurate comparisons to be made between P.radicicola and recent Phialophora isolates from Gramineae. For the same reason the type material does not allow the various conflicting senses in which the name P.radicicola has been used in recent literature (Wong and Walker, 1975; Walker, 1975, 1980) to be satisfactorily resolved. The three main characters in question are

(i) Conidia: Deacon (1974b) and Wong and Walker (1975) have shown that Gaeumannomyces graminis and some related Phialophora spp. can produce two types of conidia

(a) germinating phialidic conidia (known only in culture) which are usually straight to slightly curved, not semicircular or strongly lunate and often in the range 5-14 x 2-4 μm and

(b) non-germinating phialospores (known in culture and in nature) which are usually strongly curved, falcate to lunate or semicircular and often in the range 3-9 x 1-1.5 μm. The species of Gaeumannomyces known in culture and the other Phialophora spp. shown in Table 1 all produce type (a) conidia but their presence in P. radicicola Cain has not been demonstrated. McKeen (1952) stated that the conidia seen in this species germinated to produce normal colonies, but this has not been substantiated with these conidia from the living culture by the present author or by others (Deacon, 1974b; Wong and Walker, 1975). No one has produced satisfactory proof of germination in the type (b) conidia of these fungi. The position regarding germinating conidia in P.radicicola Cain cannot be resolved satisfactorily from the type material or the original description.

(ii) Hyphopodia: Walker (1972) found that Gaeumannomyces graminis was a hyphopodiate fungus and subsequent work on other Gaeumannomyces spp. on Gramineae and Cyperaceae has shown that hyphopodia are a constant feature of species in the genus. In this paper, Gaeumannomyces has been redefined as a hyphopodiate genus. Tests on several graminicolous Phialophora isolates have shown that they also produce hyphopodia (Wong and Walker, 1975) and hyphopodium production and shape has been used as a character of taxonomic value at the species level (Walker, 1980). Hyphopodia were not described for P. radicicola by Cain (1952) but McKeen (1952, p.346) described and figured on the surface of corn roots 'thick-walled brown, usually spherical, but sometimes elliptical, vesicles or chlamydospores.......and they always have a pore'. McKeen's original material is no longer available but it is possible that he was describing hyphopodia. The living type culture, when inoculated on to wheat coleoptiles as a test for hyphopodium production (Walker, 1972, 1975, 1980) did not produce the structures described by McKeen (1952) but did produce a few small, hyaline simple hyphopodia, similar to those seen in all the other species listed in Table 1. There is no evidence from the type specimen, the living type culture or the descriptions of Cain (1952) and McKeen (1952) that lobed hyphopodia as seen in *G.graminis* var. *graminis* are produced by *P.radicicola* Cain. Deacon's (1974b) use of the name *P.radicicola* var. *radicicola* for British and French isolates producing lobed hyphopodia is incorrect (Art.26, Stafleu *et al.*, 1972) and has been dealt with elsewhere (Wong and Walker, 1975; Walker, 1980).

(iii) *Pathogenicity and host range*: apart from McKeen's (1952) work on corn roots, there is no information on the pathogenicity of *P. radicicola* to cereals and grasses, or on the structures produced on and in roots of Gramineae. McKeen (1952) described and figured the spherical to elliptical bodies mentioned above on roots, and stated that 'sometimes numerous fine threads are formed in individual cells and other cells may be completely filled with enlarged fungus cells which later assume a thick, brown heavy wall (Figs.10 and 11).' His figures show root cells packed with brown fungal cells, and are very similar to Deacon's (1974b) Fig.20, showing similar structures in wheat roots produced by *P.graminicola* (as *P.radicicola* var. *graminicola*) and to Stetter and Leroul's (1979) Fig.4, showing similar cell clusters in barley roots produced by *Microdochium bolleyi* (Sprague) de Hoog & Hermanides-Nijhof (as *Aureobasidium bolleyi*). Deacon (1980) claims that these and similar structures in wheat roots (which he terms growth cessation structures; see Deacon, 1974b) are sufficiently constant and characteristic to provide an important means of identification of species and varieties of *Gaeumannomyces* and *Phialophora* spp. It is felt that the taxonomic reliability of these structures will need to be assessed on several hosts with a world-wide range of isolates of these and other root fungi on Gramineae before they could be used for taxonomic purposes. As far as *P. radicicola* Cain is concerned, the structures described originally are similar to those now known to be produced in cereal and grass roots by at least the two unrelated species listed above.

In these considerations of conidia, hyphopodia and pathogenicity, McKeen's (1952) original observations are of interest. He stated that conidia germinated, that brown vesicles with a pore were produced on roots and that host cells became packed with clusters of enlarged brown fungal cells. None of this can be reconciled with the type specimen of *P.radicicola* or the living type culture in CBS. However, if McKeen was using the isolate (duplicate as DAR 33708) discussed earlier and identified here as *P.graminicola*, his observations can be explained and agree closely with what is known for other isolates of *P. graminicola*

(Deacon, 1974b). It seems possible that the concept of *P.radicicola* could have been confused from the start, if *Cain (1952)* and McKeen (1952) were using two different isolates. Certainly the type specimen and type culture from CBS agree with one another and are quite distinct from the McKeen culture. Dr. McKeen (*in litt*.,1979) does not think that two different fungi were isolated in 1952.

It is thus recommended that the name *Phialophora radicicola* Cain be rejected for any isolates of *Phialophora* spp. other than the type specimen and type isolate because (a) it has been used in several different senses (Wong and Walker, 1975; Walker, 1980) and so has become a persistent source of error (Art.69, Stafleu *et al*.,1972) especially in plant pathological literature

(b) recourse to the type cannot resolve these conflicting usages

(c) the type specimen, type culture, original description (Cain, 1952) and subsequent paper dealing with the type (McKeen, 1952) show characters which are capable of different interpretations and application to several different organisms and do not show characters which would allow distinction between these various interpretations and accurate application of the name

(d) it is not possible to retypify *P.radicicola* (as some pathologists have suggested to me) as the holotype is still in existence (Art.7, Stafleu *et al*.,1972) and, in any case, selection of a neotype could not be made accurately for the reasons already given in (c).

Illustrations: Cain (1952, conidiophores, phialides, conidia, hyphae, sclerotial cells); McKeen (1952, phialides, conidia, growth in culture, and on and in corn roots); Walker (1980, simple hyphopodia).

Specimens examined: dried cultures and 13 microscope slides of cultures, isolated from roots of *Zea mays*, Chatham, Kent Co., Ontario, Canada, summer, 1950 (recd. Feb.1951), W.E. McKeen, TRTC 23660, HOLOTYPE packet and four duplicate packets, plus drawings (slides as DAR 33683); duplicate of type ex TRTC 23660, DAR 22004; same, living type culture ex CBS 296.53 (slides, dried cultures and subculture as DAR 23612).

Group 2. These isolates are all placed in the following species.

Phialophora graminicola (Deacon) Walker comb.nov.

≡ *P. radicicola* Cain var.*graminicola* Deacon, *Trans. Brit.mycol.Soc*.*63*(2), 322-323, 1974 (type in IMI !)

= *P. radicicola* sensu Scott, *Trans.Brit.mycol.Soc.55* (1), 163-167, 1970, non *P.radicicola* Cain (1952).

P. graminicola is described fully in Walker (1980). It differs from the conidial states of *Gaeumannomyces graminis* varieties and from *Phialophora* sp. (lobed hyphopodia) (see below) in having about half the growth rate on agar and in lacking curved non-germinating phialospores (see Table 1). In cultural and morphological characters, it is very similar to *G.cylindrosporus* (q.v.) and probably is its conidial state. The transfer as *P.graminicola* has been made here to remove it from the confusion surrounding the name *P.radicicola* dealt with above.

Illustrations: Deacon (1974b as *P.radicicola* var. *graminicola*, conidia, groups of pigmented cells in wheat roots); Scott (1970, as *P. radicicola*, conidiophores, phialides, conidia, pigmented cells in wheat root); Walker (1980, phialides, conidia, hyphopodia).

Specimens examined: on *Agrostis tenuis* Sibth. (bent grass), Tamworth, N.S.W., Australia, Oct.1975, P.Wong PD, DAR 26394; same, P.Wong 6H, DAR 26395. On *Bromus unioloides* H.B.K., Walcha, N.S.W., Australia, 1977, P. Wong TH3, DAR 33668. On *Lolium perenne*, Botany School Field Station, Cambridge, England, Oct.1971, J.W. Deacon P7, IMI 179703, TYPE culture (duplicate as DAR 27009). On Gramineae undet., Cambridge, England, 1966, P.R.Scott, Trans.1 (duplicate as DAR 23167); Yorkshire, England, date not given, prob. about 1971-1972, J.W. Deacon P4 (duplicate as DAR 23169). DAR 33708 ex W. McKeen (as *P.radicicola* Cain) also belongs here.

Group 3. Several isolates from England and Denmark are included here.

Phialophora sp. (lobed hyphopodia)

= *Phialophora radicicola* var.*radicicola* sensu Deacon (1974b) and PRR (or Prr) of subsequent British plant pathologists, not *P.radicicola* Cain (1952)

As mentioned earlier, Deacon (1974b) used the name *P. radicicola* var.*radicicola* for a fungus producing lobed hyphopodia found on roots of Gramineae in England and France. This is not in agreement with the type or original description of *P.radicicola* and the name cannot be used in this sense. Isolates of this fungus from England and Denmark have been studied and cannot be distinguised in culture or on morphology from the mycelial and conidial state of *Gaeumannomyces graminis* var. *graminis* (q.v.). They possibly represent isolates of *G.graminis* var.*graminis* for which perithecia have not yet been produced. Some pathologists have suggested that, as these isolates may be different from *G.graminis* var.*graminis*, they should be described as a new species of *Phialophora*. However, in studies with several isolates, nothing could be found to distinguish them consistently from *G.graminis* var.*graminis*. Isolates of *G.graminis* var.*graminis* and of *Phialophora* sp. (lobed hyphopodia) show some variability in cultural characteristics (especially amount of aerial mycelium and depth of colour) and conidial shape and size varies within and between isolates (Fig.48). Such variation is only to be expected in such a common widely distributed fungus. Study of more isolates and searches for the possible perfect state are required. In the meantime, the common name *Phialophora* sp. (lobed hyphopodia) provides a convenient label for isolates showing these characters, without any nomenclatural complications in *Phialophora*.

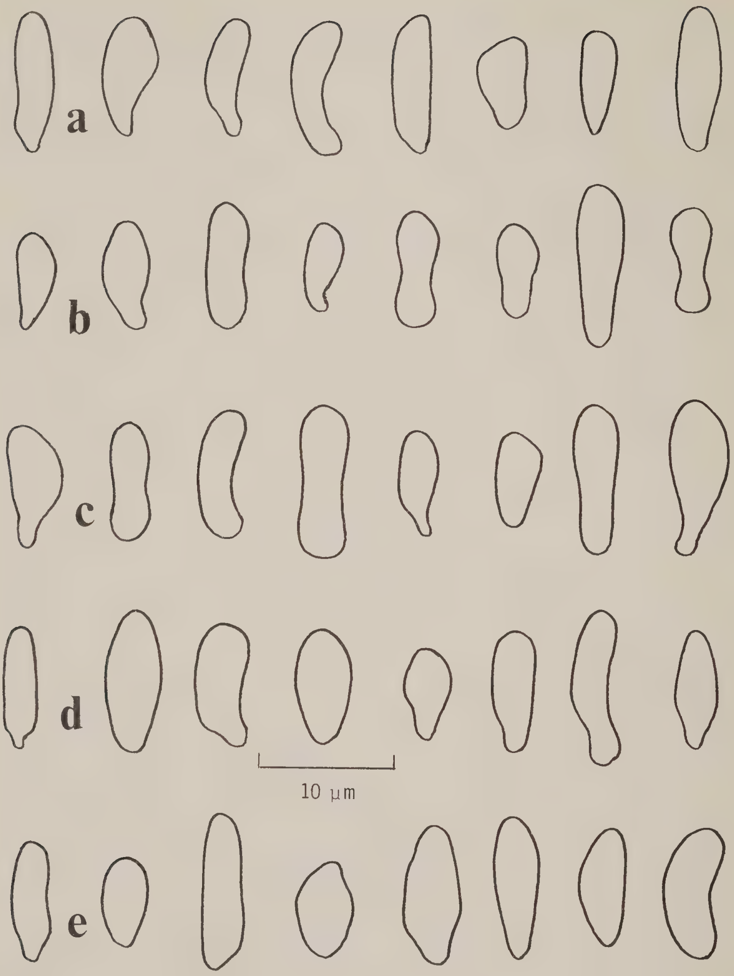

Figure 48. Germinable conidia of Gaeumannomyces graminis var. graminis (a and b) and Phialophora sp. (lobed hyphopodia) (c-e). a. DAR 30584 (N.S.W.); b. DAR 30585 (N.S.W.); c. DAR 22971 (England); d. DAR 25444 (England); e. DAR 33674 (Denmark).

Table 1: Grouping of *Phialophora* isolates from roots of Gramineae

Name	Ascospores Range in µm		Hyphopodia			Conidia		Growth rate	Optimum temperature
	Length	Width	Simple	Slightly lobed	Lobed	Germinating	Non-germinating	mm/24hrs	°C
Group 1									
Phialophora radicicola Cain (type)	-	-	+	-	-	-*	+	10-12	25-30
Group 2									
P. graminicola	-	-	+	+	-	+	-	4-6	20-25
Gaeumannomyces cylindrosporus	35-75	3-6	+	+	-	+	-	4-6	25
'*P. radicicola*' ex W. McKeen DAR 33708	-	-	+	+	-	+	-	4-6	25
Group 3									
P. sp. lobed hyphopodia	-	-	+	-	+	+	+	6-12	20-28
G. graminis var. *graminis*	70-110	2,5-4	+	-	+	+	+	8-12	20-30
Group 4									
G. graminis var. *avenae*	85-140	2,5-4	+	-	-	+	+	6-10	20-25
G. graminis var. *tritici*	60-110	2.5-4	+	-	-	+	+	6-10	20-25

* see discussion in text

In eastern Australia, where G.graminis var. graminis occurs commonly on a range of grasses, isolates vary greatly in their ability to produce perithecia and some have failed to do so. Whilst these isolates show a range of cultural characters and optimum temperatures for growth (see Table 1 and Walker, 1980), all resemble one another and cannot be distinguised from isolates of Phialophora sp. (lobed hyphopodia) from England and Denmark.

Illustrations: Deacon (1974b as P.radicicola var.radicicola,conidial germination, pigmented cells in wheat roots); Walker (1980, conidial germination, hyphopodia).

Specimens examined: all cultures, isolated from: Hordeum vulgare, Denmark, about 1975, S. Stetter and N. Leroul, culture sent by Dr. J. P. Skou as SpF74, DAR 33674; same, sent as SpF104, DAR 33675 (these isolates were referred to by Stetter and Leroul (1979) as 'Phialophora radicicola Cain' and illustrations of moniliform hyphae, conidiophores, phialides and curved phialospores given; the present author produced lobed hyphopodia and germinating conidia from these isolates); from Secale cereale L., Suffolk, England, August 1969, P.R. Scott, DAR 25444 (isolate P18 of Deacon, 1974b); from Zea mays, Essex, England, May 1972, J.W. Deacon G6, DAR 22971.

Grouping of isolates

The four groups of isolates and their characteristics are listed in Table 1. There is no suggestion intended that the characters listed are of equal value and, at the species level, more attention should probably be paid to morphology than to cultural growth rates and optimum temperatures. In such a widespread group of fungi, it could be expected that isolates of the same species from different geographic regions may show cultural and temperature differences. Moreover, the terms 'germinating' and 'non-germinating' for conidia arise from Wong and Walker (1975) and do not indicate other important morphological differences between the two types (see discussion in Wong and Walker, 1975 and Walker, 1980). The germinating conidia are of various shapes, but generally straight or slightly curved and usually from 1.5-4 μm wide. The non-germinating conidia are usually slightly to strongly curved or semicircular and from less than 1 to 1.5 μm wide.

PLAGIOSPHAERA

Plagiosphaera Petrak, Ann.Myc.39 (4-6), 289, 1941
Type sp. P.moravica (Petrak) Petrak, now as P.immersa (Trail) Petrak.

Petrak (1941) based his new genus on Ophiobolus moravicus Petrak (1921) found on dead stems of Urtica dioica in Austria. Later, he found that Ophiobolus immersus Trail provided an earlier epithet and made the new combination P.immersa (Trail) Petrak (1960). Dennis (1975) provided a detailed description and illustration, reduced Ophiobolus *brachysporus* Fautr. & Roum. to synonymy, and commented on Trail's collections and Petrak's use of the epithet '*immersa*'. A brief description prepared from the specimens examined is given.

Perithecia similar to those of *Gaeumannomyces*, embedded in stem tissue, with a lateral (or occasionally central) erumpent neck, and containing several unitunicate *asci*, 65-80 x 7-8 µm, with a small, distinct, apical ring. *Ascospores* parallel or loosely spirally twisted in the ascus, hyaline, slightly curved, 45-65 x 2-2.5 µm, with rounded apex, tapering to a thinner base, and with three or more indistinct septa. There is no associated superficial mycelium.

In the context of the cereal take-all fungi, *Plagiosphaera* is similar to *Gaeumannomyces* in characters of perithecia, asci, and ascospores. Holm (1948) noticed the similarity and suggested that '*Ophiobolus graminis*' was closely allied to *Plagiosphaera*. In recent keys (e.g. Kobayashi, 1970; Bolay, 1971; Müller and von Arx, 1973), *Gaeumannomyces* (as *Linocarpon* in Kobayashi, 1970) and *Plagiosphaera* are placed close to one another and separated only on neck position, lateral in *Plagiosphaera* and central in *Gaeumannomyces*. However, members of both genera appear to vary in this character and presence of a superficial hyphopodiate mycelium and parasitic habit in *Gaeumannomyces* and its absence and saprophytic habit in *Plagiosphaera* seem to be more reliable differential characters.

During this work, the type specimen of *Ophiobolus moravicus* has not been available for study. Two other collections identified by Petrak have been examined and the fungus present agreed with the original description, and with that given by Dennis (1975).

Specimens examined: on dead stems of *Aconitum napellus* L. aggr., Niederösterreich, July 1939, F. Petrak, IMI 22266 (slides as DAR 34132). On dead stems of *Urtica dioica* L., Mähr-Weisskirchen, Austria, 1924, F. Petrak *Flora Moravica* 189, FH (marked co-type, but although on the type host from the type locality, this specimen is not the type collection which was made on 11.ix.1915, see Petrak, 1921; slides as DAR 34133).

Other names in Plagiosphaera

Plagiosphaera bhargavai Müller, *Sydowia* **12** (1958), 180-182, 1959 (type not examined).

This was described from a single collection on dead branches of *Lonicera quinquelocularis* Hardw. from India. It has perithecia with a lateral ostiole, embedded in a clypeate tuberous stroma, and from the description does not seem to be congeneric with the non-stromatic *P.immersa*. It is perhaps more closely related to *Linospora* Fckl.

Plagiosphaera muroiana (Hino & Katumoto) Walker comb.nov.

≡ *Linocarpon muroianum* Hino & Katumoto, *J.Jap.Bot.* **41** (10), 296-297, 1966 (type in YAM !, listed by Hino & Katumoto as FAUY).

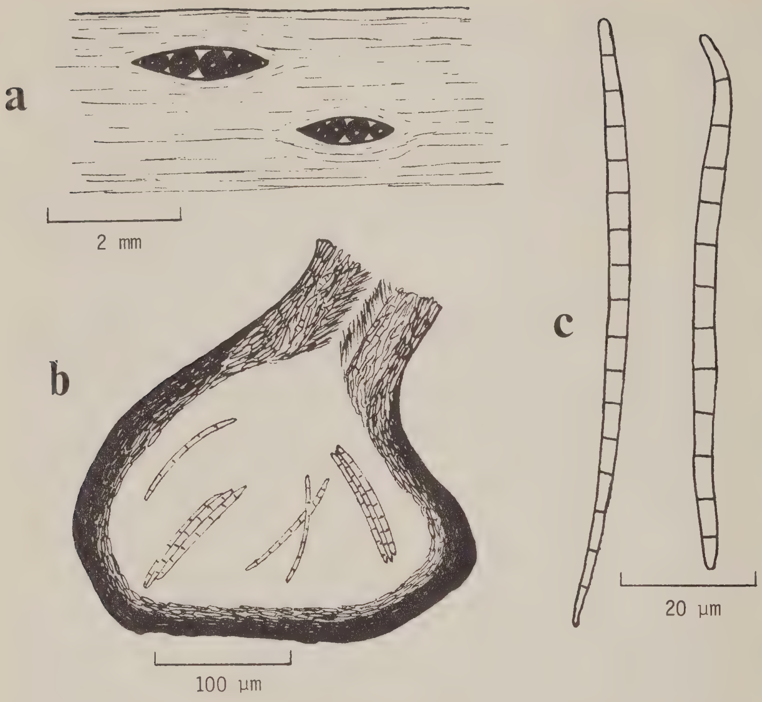

Figure 49. Plagiosphaera muroiana, from holotype in YAM (slide DAR 31877). a. habit; b. section ascocarp; c. two ascospores.

Perithecia (Fig.49) embedded in bamboo stem, with necks erumpent through stem tissue and (where present) through overlying leaf sheaths, clustered in loose groups of 3-6, often arranged in a line along the stem up to 2-2.5 mm long and less than 1 mm wide. When the firm outer layer of bamboo is removed, the black perithecia are seen to be loosely to tightly packed in the stem cortex. Body of perithecium black, 300-500 µm diam, subglobose to oval, with a central or eccentric black erumpent neck, 80-100 µm wide and up to 100 µm or more long, longer where leaf sheaths present, many broken off, internally white, lined with thin walled periphysis-like hyaline hyphae 2-2.5 µm wide, which appear to break down to form ostiolar canal. {Asci cylindrical to elongated clavate with small ring in slightly thickened, rounded apex, thinner at the base, shortly stipitate, eight-spored, 105-145 x 10.5-13.5 µm}. Ascospores (Fig.49) in a parallel bundle, not twisted, elongated fusiform, widest in the middle and tapering slightly to the rounded ends, 80-90 x 4 µm, with 10-16 septa 4-9 µm apart, septa prominent in some spores, paraphyses not seen. Stromatic tissue not observed; a few brown hyphae 3-4 µm wide attached to lower outer wall of perithecium and some similar hyaline hyphae seen in host tissue under perithecium.

Illustrations: Hino and Katumoto (1966, asci, ascospores, paraphyses); Kobayashi (1970, habit, section ascocarp, asci, ascospores).

Specimen examined: on dead culm of *Sasa kurilensis* Makino & Shibata, Mount Nyûtô, Akita, Japan, 4.viii.1957, H. Muroi, YAM, HOLOTYPE (slides as DAR 31877).

All perithecia examined were over-mature and asci were not observed. The description of asci given above is taken from the descriptions, drawings and photographs given by Hino and Katumoto (1966) and Kobayashi (1970). Abundant ascospores, often still arranged in bundles of eight, were present as a dry pale mass inside the perithecia.

Although Hino and Katumoto (1966) described stromata for this species, no sign of stromatic tissue was found. The perithecia were packed tightly in groups in the stem tissue with no surrounding stromatic tissue, no clypeus and no discolouration of the host tissue above or surrounding them. A few hyphae were found attached to the perithecia and in the tissue but there was no obvious development of any associated superficial mycelium on the stem or leaf sheaths. Ascospores were somewhat shorter than those described originally (87-124 x 3-3.5 μm) but agreed better with the measurements given by Kobayashi (1970; 75-100 x 4-4.5 μm). This species is more suitably placed in the non-stromatic genus *Plagiosphaera* than in the clypeate, partly stromatic genus *Linocarpon* (q.v.). It is the first *Plagiosphaera* recognised on a monocotyledonous plant (see below under *Plagiosphaera* sp. on *Iris*) and has larger asci and ascospores than the other species accepted here.

Plagiosphaera platensis (Speg.) Walker comb.nov.

≡ *Winterella platensis* Speg., *Ann.Mus.Nac.Buenos Aires* *19* (Ser.3,12), 403, 1909 (type in LPS !)

Perithecia embedded in stem tissue, single or several clustered together, black, body globose to subglobose or oval, 200-400 μm diam with an erumpent eccentric to lateral neck 80-100 μm wide and up to 250 μm long, many broken, often running laterally for some distance under host tissue before becoming erumpent; ostiolar canal to 30 μm wide, lined with hyaline hyphae 2-2.5 μm wide, no periphyses seen. *Asci* unitunicate, long cylindrical, 80-100 x 10-14 μm, with a small distinct apical ring 2 μm diam, eight-spored. *Ascospores* filiform, lying parallel in one bundle, faintly yellowish in mass, hyaline to faintly tinted singly, 70-75 x 2-2.5 (3) μm, several indistinct septa.

Specimen examined: on dead stem of *Phytolacca* (as *Pircunia*) *dioica* L., Buenos Aires, Santa Catalina, Argentina, Nov.1905, C. Spegazzini, LPS 851, HOLOTYPE (slides as DAR 34134).

In LPS, the original packet marked '*Winterella platensis* Speg.n.sp.' is filed in an outer, later packet marked '*Trichospermella platensis* Speg.'. As far as can be seen (Farr, 1973), Spegazzini did not publish this name. The fungus is certainly not congeneric with the type species of *Trichospermella* Speg. (*T.pulchella* Speg.)

(Walker, unpublished) but is a typical *Plagiosphaera*, close to *P.immersa*. It has slightly longer ascospores than those described for this species, but may not be specifically distinct.

Plagiosphaera quercicola Kobayashi, *Mem.Nat.Sci.Mus.Tokyo* **9**, 88-89, 1976 (type not examined).

P. quercicola was described from wilting leaves of newly felled *Quercus salicina* Bl. trees in Japan. Kobayashi (1976) also mentioned a smaller spored unnamed species of *Plagiosphaera* causing a white circular leaf spot on *Quercus glauca* Thunb. in Japan. The exact generic position of these possibly parasitic species has not been studied here but they may be closer to various leaf inhabiting species of *Pleuroceras* Riess (see Barr, 1978) than to the saprophytic species of *Plagiosphaera* on dicotyledonous stems.

Plagiosphaera umbelliferarum (Barr) Barr, *The Diaporthales in North America*, p.123, 1978.

≡ *Linocarpon umbelliferarum* Barr, *Canad.J.Bot.* **39**, 320-321, 1961 (type in DAOM !)

A detailed description was given by Barr (1961). In size of perithecia, asci and ascospores, this fungus is very similar to *P.immersa* and may not be specifically distinct from it. Barr (1978) considered that *Gaeumannomyces leptosporus* Iqbal may be the same but Iqbal's species is considered here to be best placed in *Ophioceras*; see under *Ophioceras leptosporum*.

Illustrations: Barr (1961, ascocarp, ascus and detail of ascus tip, ascospores).

Specimen examined: on dead stem of *Heracleum lanatum* Michx.,Lac Diable, Mt. Albert, Quebec, Canada, 19.viii.1957, M.E. Barr 2198A, DAOM 74274, TYPE (slides as DAR 34116).

Plagiosphaera sp. on *Iris*

In discussing *Sphaeria eucrypta* Berk.& Br., described on *Carex pendula* L., Walker (1972) mentioned collections under this name in various herbaria on *Iris foetidissima* L. The status of the epithet '*eucrypta* Berk.& Br.' and the possible identity of the fungus on available specimens of Cyperaceae is discussed under *Gaeumannomyces* spp. on Cyperaceae. However, the *Iris* collections show a different organism, which is not a *Gaeumannomyces*, but can be placed tentatively in *Plagiosphaera*.

Perithecia embedded in leaf tissue, dark brown to black, body globose to oval 250-300 µm diam, with a long erumpent neck up to 300 µm long, 50 µm wide, placed eccentrically on the body and often running horizontally in the tissue before it pierces the surface. *Asci* unitunicate, 70-90 x 6-9 µm, with a refringent apical ring seen as two short rods in side view, eight-spored. *Ascospores* hyaline to pale yellow, lying parallel in one fascicle, 50-60 x 1.5-2 (2.5) µm, several indistinct septa. No superficial hyphae present.

In length of asci and ascospores, this is very similar to P. immersa but ascospores are somewhat narrower. Further collections on Iris are needed to clarify both the generic and specific identity of this fungus.

Specimens examined: all on Iris foetidissima; Batheaston, 7.i.1859, collector not given, K; Batheaston, Jan.1859, C.E. Broome, Rabh. F. Europ.49, two duplicates in K and one in L (all as Sphaeria eucrypta Berk.& Br.). A fragment of thick leaf marked 'Ophiobolus eucryptus (Berk.& Br.) Sacc.' with no further information, in PAD, is probably portion of this Iris collection.

Plagiosphaera sp. on Quercus glauca - see P.quercicola above.

RHAPHIDOPHORA

The generic name Rhaphidophora Ces.& de Not. (Fungi) described in 1861 is a later homonym of Rhaphidophora Hassk. (Araceae) published in 1844 (Saccardo, 1883, p.337). The former name is thus illegitimate and to be rejected for use in the fungi (Art.64). The few Rhaphidophora names in this paper are disposed as follows:

Rhaphidophora graminis Sacc.(1875) - this is Gaeumannomyces graminis (Sacc.) von Arx & Olivier var graminis (q.v.).

Rhaphidophora herpotricha (Fr.) Tul.(1863) - placed here as Ophiosphaerella herpotricha (Fr.) Walker (q.v.).

Rhaphidophora leptosperma Speg. (1880) - placed here as Ophiosphaerella leptosperma (Speg.) Walker (q.v.).

Rhaphidophora maritima Sacc.(1878) - type sterile; for discussion and synonymy, see Walker (1972); see also under Linocarpon maritimum.

RHAPHIDOSPORA

The generic name Rhaphidospora Fr.& Mont.(Fungi) published in 1849 is later homonym of Rhaphidospora Nees (Acanthaceae) published in 1832 (Saccardo, 1883, p.337). The former name is thus illegitimate and to be rejected for use with fungi (Art.64). The Rhaphidospora names in this paper are disposed as follows:

Rhaphidospora herpotricha (Fr.) Fckl.(1870) - placed here as Ophiosphaerella herpotricha (Fr.) Walker (q.v.).

Rhaphidospora leptosperma (Speg.) Cke.(1889 as 'Raphidospora leptosperma Cke.') - placed here as Ophiosphaerella leptosperma (Speg.) Walker (q.v.).

Several of the epithets used in this paper in Acanthophiobolus, Gaeumannomyces, Ophiosphaerella and Sphaeria were listed by Cooke (1889) under Rhaphidospora (as 'Raphidospora'). They are not relisted here.

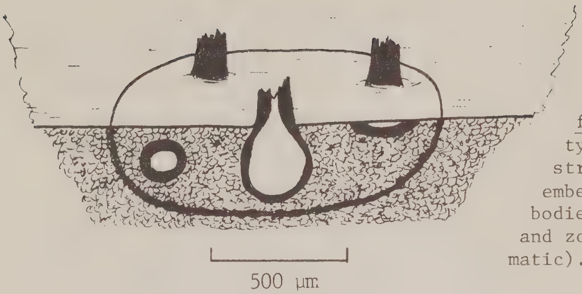

Figure 50. Schizacrospermum filiforme, from type in FH, section stroma showing embedded fruiting bodies, broken necks and zone line (diagrammatic).

SCHIZACROSPERMUM

Schizacrospermum P.Henn., Monsunia 1, 170, 1899

Type sp. S.filiforme P.Henn & E.Nym. in P.Henn (type in FH !)

≡ Ophioceras filiforme (P.Henn.& E.Nym.) v.Höhnel, Sitzungsber.Kaiserl.Akad.Wiss., Math.-Naturwiss. Kl.,120, 432, 1911 (as 'P.Henn.) v.Höhn.').

S. filiforme was described from rotting leaf sheaths of Amomum sp. (Zingiberaceae) collected in Java. Its description may be summarised as follows:

Perithecia solitary to subcaespitose, erumpent-superficial, fleshy membranaceous but horny when dry, black, filiform, 3-5 mm long, 150-180 µm wide, with a bluntly rounded yellowish-brown apex with a pore, yellow inside. Asci clavate to fusoid, eight-spored, 100-120 x 10-13 µm. Ascospores filiform, parallel, obtuse to acute, hyaline to pale yellowish, multi-septate, 80-100 x 3-3.5 µm.

The associated discussion spoke of perithecia arising singly or in groups from a black layer in the leaf tissue. The illustrations showed a piece of leaf sheath with several long filiform necks protruding singly or in groups from it. The ascospores are figured as about 12 septate, without swollen cells and slightly but definitely constricted at each septum.

Höhnel (1911) examined portion of the type collection and found embedded globose fruiting bodies with long erumpent necks. Asci were said to be 120 x 13 µm and ascospores pale brown, filiform and septate. Höhnel concluded that Hennings had overlooked the embedded globose bodies of the perithecia and described the necks only as filiform perithecia. He placed the fungus in Ophioceras.

The portion of the type from Höhnel's herbarium in FH has been examined. It consists of one piece of leaf sheath with several globose to subglobose fruiting bodies 250-400 µm diam embedded in the tissue. They are brown, usually in groups of 3-5 and each group is surrounded completely by a dark zone line of fungal tissue, seen on the leaf sheath surface as a dark line around the group and in the tissue as a black plate around and under the fruiting bodies (Fig.50). This zone line is a layer of host cells completely invaded by the fungus, each cell being tightly packed with a mass of dark brown irregularly shaped fungal cells up to 11 x 6 µm. The plate is very similar to that seen surrounding the ascocarps of some species of Lophodermium and termed aliform mycelium by Tehon (1935). The wall of the individual fruiting bodies is pale brown to brown, 15-20 µm thick, of several layers of cells, the outer layer a textura angularis of cells 8-14 µm diam. Most of the long necks described originally had broken off but a few necks to 100 µm long were seen. These were dark brown to black, 150 µm wide of several layers of dark brown cells 5-10 µm diam and with a central canal 40-50 µm wide. No sign of asci, ascospores, paraphyses or periphyses was seen in this collection.

As Höhnel (1911) suggested, it seems that Hennings probably described the long necks as the whole fruiting body. The fungus appears to be a stromatic ascomycete of some sort and is probably not a species of Ophioceras (q.v.). In the absence of asci and ascospores, no further comment on its possible relationships can be made.

Illustrations: Hennings (1899, Taf.V. Fig.17, habit, neck of ascocarp, ascus, ascospores, paraphyses).

Specimen examined: on dead leaf sheath of Amomum sp.,Tjibodas, Java, collection date not given on label, in Herb. F.v. Höhnel a.n. 3806 in FH, portion of TYPE (slides as DAR 34137). The date '1907-1908' on the packet is presumably when this portion was sent to Höhnel. In the original description, the specimen was collected by E. Nyman on 4.vii.1898 at Tjibodas, Java.

SPHAERIA

Sphaeria Haller ex Fries, Syst. Mycol.1, lii,1821

Type sp. S.rubra, Fragi similis Haller = S.fragiformis Pers. ex Hook. (Stafleu et al., 1972, p.256).

The name Sphaeria has been used for a wide range of perithecial and pseudothecial species. The type species is regarded as a species of Hypoxylon Bull.ex Fr.(nom.cons.) (Stafleu et al., 1972, p.256). Several Sphaeria names for scolecospored species are discussed.

Sphaeria cariceti Berk.& Br., Ann.Mag.Nat.Hist.,ser.3,7, 455, 1861 (type in K !)

Results of examination of the type and other specimens in K and detailed discussion of the epithet 'cariceti Berk. & Br.' were given by Walker (1972). The name is not available for use. The original collections do not show characters which would allow the fungus to be identified and the epithet applied accurately. As Ophiobolus cariceti (Berk.& Br.) Sacc. and Linocarpon cariceti (Berk.& Br.) Petrak, it has been applied to the wheat take-all fungus, here listed as Gaeumannomyces graminis (Sacc.) von Arx and

Olivier var. *tritici* Walker (q.v.); see also Walker (1980).

Sphaeria chaetophora Crouan (1867) - a synonym of *Acanthophiobolus helicosporus* (q.v.).

Sphaeria coffeata Berk. in Hook., *Fl.N.Z.* II, 205, 1855 - identity unknown, no specimen available (Walker, 1972).

Sphaeria culmorum Wallr., *Fl. Cryptogam.Germ.*,Pars Posterior: 770, 1833 (type not seen).

This species, described on rotting culms of *Scirpus lacustris* L. and '*Juncus laevis*', with dark brown globose fruiting bodies in lines on blackened areas has not been studied and its identity is not known. It was mentioned by Walker (1972).

Sphaeria culmorum Cke, *Grevillea* 3, 68, 1874 (type not seen)

Wehmeyer (1961) discussed this species which he placed as a synonym of *Pleospora phaeocomoides* (Berk.& Br.) Wint. var. *infectoria* (Fckl.) Wehmeyer. The name is a later homonym of *S. culmorum* Wallr. and *S.culmorum* Crouan.

Sphaeria culmorum Crouan in Crouan & Crouan, *Fl.Finist*.26, 1867 (type in CO !) - details of this species, which cannot be identified from the type specimen, were given by Walker (1972). The name is a later homonym of *S.culmorum* Wallr.

Sphaeria dolichostoma Berk.& Curt. - see under *Ophioceras dolichostomum* (Berk.& Curt.) Sacc.

Sphaeria eucrypta Berk.& Br. - for discussion of specimens on Cyperaceae under this name, see '*Gaeumannomyces caricis* and *G*.spp. on Cyperaceae'. For *Iris* specimens, see '*Plagiosphaera* sp. on *Iris*'. See also Walker (1972) for discussion of specimens and synonymy.

Sphaeria helicospora Berk.& Br. - placed here as *Acanthophiobolus helicosporus* (Berk.& Br.) Walker (1972)(q.v.).

Sphaeria herpotricha Fr. - see *Ophiosphaerella herpotricha* (Fr.) Walker.

Sphaeria littoralis Crouan - for discussion of this species, see Walker (1972).

Sphaeria oedema Mont. - see under *Ophiobolus oedema* (Mont.) Sacc.

Sphaeria penicillus Schmidt ex Fr.,*Syst.mycol.2*,508,1823.

Fries (1823) based this species on a collection on herbaceous stems from the Lausitz region of East Germany. The covered black, smooth, glabrous perithecia were said to have a globose body, dark coloured inside, and the thick, very short papillate, cylindrical erumpent neck was said to have very short hairs at its apex.

Subsequent authors have interpreted the name in various ways and specimens bearing the name often do not show the same species. The results of investigations of *S*.

penicillus will be presented in a separate publication. It has no bearing on the nomenclature of the cereal take-all fungi; its relationship to *Ophiobolus* Riess and *Nodulosphaeria* Rabenh. will be dealt with elsewhere.

Sphaeria stictispora Cke.& Ell., - see under *Ophiobolus stictisporus* (Cke.& Ell.) Sacc.

Sphaeria verminosa Mont. - see under *Ophiobolus verminosus* (Mont.) Sacc.

SPHAERULINA

Sphaerulina Saccardo, *Michelia* **1**, 399, 1878
Lectotype sp. *S.myriadea* (DC.ex Fr.) Sacc. (see Barr, 1972; von Arx and Müller, 1975).

The genus is discussed and several species described by Barr (1972). One species on leaves of Cyperaceae which should be included in *Sphaerulina* is described.

Sphaerulina antarctica (Speg.) Walker comb.nov.

≡ *Linospora antarctica* Speg., *Bol.Acad.Nac.Cienc. Republ.Argent.Córdoba* **27** (4), 377-378, 1924 (type in LPS !)

Ascocarps small, dark brown, at first embedded, later erumpent, 100-150 µm diam, wall to 30 µm thick, of several layers, outer layer of oval dark brown thin-walled cells 10-15 x 7-12 µm, inner layers paler, of subglobose cells 6-10 µm diam, centrum lined with thin layer of hyaline flattened cells, ostiole central, not well developed, 15-20 (25) µm diam. *Asci* 8-10 per ascocarp, broadly clavate to almost saccate, 55-77 x 22-28 µm, bitunicate, wall to 6 µm thick at the apex, apical apparatus not seen, eight-spored. *Ascospores* hyaline, cylindrical to narrowly clavate, slightly curved, rounded at each end, 40-60 x 5-7 µm with 3 transverse septa, lying parallel or slightly intertwined at 2-3 levels in the ascus. *Paraphyses* not seen. See Figs. 45 to 47.

Illustrations: Spegazzini (1924, as *Linospora antarctica*, habit, ascocarp, asci, ascospores.

Specimen examined: on dead leaves of *Carpha schoenoides* Banks & Soland. ex Hook., Sholl Bay, Capitan Aracana Island, Chile, 13.i.1923, C. Spegazzini, LPS 883, HOLOTYPE (slides as DAR 33289).

The asci and ascospores in the type are somewhat smaller than the measurements of 80-110 x 25-35 µm and 65 x 5-6 µm respectively given in the original description (Spegazzini, 1924) and in Spegazzini's notes and drawings on the type packet. Possibly the few ascocarps examined had mainly immature asci present. In all other respects, present observations on the type agree with the original description. It is a typical *Sphaerulina* and quite distinct from the diaporthaceous genus *Linospora*.

On the original packet, the name is written as *Linospora subantarctica* Speg. (n.sp.) but it was published as

L. antarctica (Spegazzini, 1924; Cash, 1972; Farr, 1973). The slight differences in locality information found in the literature for this species are discussed under *Lophodermium magellanicum* (Speg.) Walker, collected at the same time.

WINTERELLA

For *Winterella platensis* Speg. see *Plagiosphaera platensis* (Speg.) Walker.

A NOTE ON HYPHOPODIA AND APPRESSORIA

Emmett and Parbery (1975) and Parbery and Emmett (1977) have classified all fungal structures that adhere to plant surfaces and produce one or more infection threads, as appressoria. They include in this term structures named hyphopodia, stigmatopodia (or stigmopodia), stigmatocysts, node cells, infection cushions and infection plaques as well as the swollen structures often found on germ tubes generally referred to as appressoria. They considered that use of a definition based on function avoided problems associated with definitions based on morphology alone. On this basis, they gave a comprehensive review of appressoria, their morphology and function, factors influencing their formation, and the distribution of different types of appressoria in various taxonomic and ecological groups of fungi. In studies of the cereal take-all and related fungi, consideration has been given to the terms applied to the various vegetative structures they form on and in host tissue. It is concluded that use of the term appressorium in the wide sense of Emmett and Parbery (1975) and Parbery and Emmett (1977) is not always appropriate.

Walker (1972) discussed the basis of the use of the term hyphopodium for hyphal structures produced by the cereal take-all fungi. Much earlier, Mangin (1899) and Arnaud (1918) had recognised them as attachment and penetration structures and Arnaud (1918) compared them directly with the hyphopodia of the Meliolales and Asterinales and stated 'L'étude des champignons du Piétin des céréales expose d'une façon lumineuse la nature des organes perforants des Astérinées'. In many genera of Meliolales and Asterinales, hyphopodium formation occurs abundantly and regularly on epiphytic hyphae; in the cereal and grass fungi, some epiphytic hyphae (e.g. the runner hyphae and hyphal strands of *G. graminis* var. *tritici*) do not form them and hyphopodia are formed in a much less regular fashion on the associated network of branched epiphytic hyphae. The different hyphal types in these fungi are mentioned further in Walker (1980).

In *Gaeumannomyces* spp. and related *Phialophora* spp., hyphopodia have been shown to be of taxonomic value in identifying species and varieties (Walker, 1972, 1980).

Moreover, recognition of Gaeumannomyces as a hyphopodiate genus has helped clarify its separation from some other genera of Diaporthales. In the fungi as a whole, production of hyphopodia seems to be limited to genera in a relatively few orders in contrast to appressoria produced on germ tubes which, as Parbery and Emmett (1977) have shown, occur widely in all the main groups of fungi. Hyphopodia have been found in the following orders:-

Pleosporales e.g. Leptosphaeria narmari Walker & Smith (1972) and L. korrae Walker & Smith (1972), Phaeosphaeria herpotrichoides (de Not.) L.Holm (Mangin, 1899, Arnaud, 1918). In the graminicolous species, the hyphopodia are non-specialised and very similar to the simple hyphopodia and infection cushions seen in Gaeumannomyces spp.. von Arx and Müller (1975) and von Arx (1979) also tentatively placed Magnaporthe salvinii (Catt.) Krause & Webster and Buergenerula spartinae Kohlmeyer & Gessner here. The superficial hyphae of the conidial state (Nakataea sigmoidea (Cav.) Hara) of M.salvinii produce lobed hyphopodia (see Ou, 1972, pp. 235-238 and fig.iv-5). The known hyphopodiate species are mainly root, crown, stem and leaf sheath parasites of Gramineae.

Asterinales - see Theissen (1913) for Asterina, and von Arx and Müller (1975) for various genera in the families Asterinaceae, Englerulaceae and Parodiellinaceae. Hyphopodia are lateral (occasionally intercalary) and simple or lobed; all are leaf (or branch) parasites on a wide range of plants, with many species having a range restricted to a small number of hosts.

Erysiphales - see Homma (1937) and Clare (1964) where these hyphal structures are referred to as appressoria. Differences in shape, size and arrangement appear to be one of the characters of value in helping identify some conidial forms in the absence of perithecia. There seems to be no reason why the hyphal infection structures in the Erysiphales should not be referred to as hyphopodia. This would also help distinguish them from appressoria produced on germ tubes, which also have some taxonomic value (Homma, 1937; Ballantyne, 1975). All are parasites on a wide range of plants.

Meliolales - see Hansford (1961, 1963). In this order capitate and mucronate hyphopodia are distinguished. The former are very important taxonomically in their shape, size, position relative to one another and to mucronate hyphopodia, frequency and arrangement on the hyphae. The structures termed mucronate hyphopodia are not penetrating organs and their necks are usually directed up away from the host surface (Hansford, 1961). Their function is not known and Goos (1974, from Goos and Gessner, 1975) suggested that they are apparently without function. Hughes (1978) found phialoconidia produced from the open tip of mucronate hyphopodia of Asteridiella knightiae Hughes in New Zealand. This seems to be the first record of such an occurrence and may give a clue to the function of these structures. The term hyphopodium may be inappropriate for them (Goos and Gessner, 1975) but as it has been used so widely in the literature on the Meliolales, its retention is suggested at present. The Meliolales are parasites on a wide range of plants.

Diaporthales - known only in Gaeumannomyces spp. (Walker, 1972, 1980) and also in Magnaporthe salvinii (Catt.) Krause & Webster (1972) if it is placed here (see under Pleosporales and Phyllachorales). Both simple and variously lobed hyphopodia are produced by Gaeumannomyces spp. and related Phialophora spp. The hyphopodiate species are parasites of Gramineae and Cyperaceae.

Phyllachorales - lobed hyphopodia are produced by Buergenerula spartinae Kohlmeyer & Gessner (1976; Goos and Gessner, 1975 as Sphaerulina pedicellata Johnson) and by the conidial state of Magnaporthe salvinii. There is some difference of opinion concerning the placement of these species (see Pleosporales,and Barr, 1976b and von Arx,1979 for Buergenerula). Both are parasites of Gramineae. Barr (1978) considered that Glomerella v. Schrenk & Spaulding is best placed in this order and similar simple and lobed hyphal structures have been described for some Colletotrichum conidial states (see below).

Basidiomycotina - No example of true hyphopodia in the Basidiomycetes has been found. Dodman et al. (1968a,b) have shown that some isolates of Rhizoctonia solani Kühn form lobed penetration structures on the superficial mycelium on the host and they contrast these with isolates which penetrate by forming dome-shaped infection cushions. In some respects, these structures are similar to the hyphopodia and infection cushions of Gaeumannomyces graminis varieties. Dodman et al. (1968b) were unable to obtain formation on artificial surfaces.

Coelomycetes - appressoria produced from vegetative hyphae were described and illustrated by Sutton (1968) for Colletotrichum graminicola (Ces.) Wils. and C.falcatum Wint.. These are indistinguishable from the hyphopodia produced by many fungi in the preceding orders. Sutton was able to use differences in these structures to separate isolates into three groups and he commented that appressoria produced on germ tubes did not show these differences. See also Glomerella under Phyllachorales.

Hyphomycetes - Ellis (1971, 1976) listed several genera of dematiaceous hyphomycetes with hyphopodiate mycelia. Some have perfect states in various genera of Asterinales. Some Phialophora spp. related to Gaeumannomyces also produce hyphopodia (Walker,1980).

The majority of fungi in which hyphopodia have been found are parasites and form a more or less extensive epiphytic mycelium on their host. Apart from those whose perfect state is unknown, all are confined to six orders of Ascomycotina. In contrast, fungi which produce appressoria on their germ tubes include epiphytic and endophytic species in many orders of the fungi (Parbery and Emmett, 1977). There appears to be no correlation between ability to form germ tube appressoria and ability to form hyphopodia on vegetative hyphae. Some fungi form both, and then they may be similar (e.g. in Meliolales, see Hansford 1961) or distinct (e.g. in some Erysiphales, see Homma, 1937). In Barr's (1976a) tentative 'family tree' of the Ascomycotina, the six orders are seen to be placed in different branches, although the Erysiphales, Meliolales

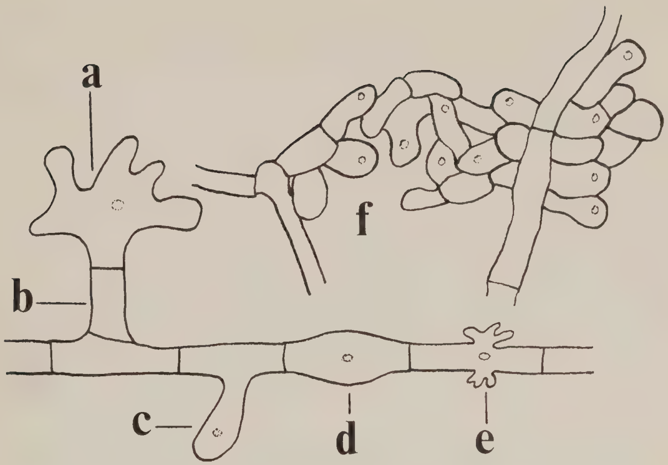

Figure 51. Diagram of hyphopodia and terms used. a. and b., stalked lobed hyphopodium with stigmatocyst (a) and stigmatopodium (b); c. sessile unlobed hyphopodium; d. unlobed intercalary hyphopodium (node cell); e. lobed intercalary hyphopodium as seen in some Erysiphales; f. developing plate mycelium (cluster of simple hyphopodia) in Gaeumannomyces graminis.

and Diaporthales are adjacent to one another. Possibly hyphopodia have developed on several occasions in these fungi, as a mechanism for penetration of surfaces by superficial hyphae. Hyphopodia seem to be essentially a surface phenomenon; in Gramineae and Cyperaceae where several layers of leaf sheaths may surround the stem, they can be found on the stem surface covered by the sheaths and also on surfaces in successive leaf sheath layers. On rare occasions they have been recorded inside plant tissue. Nilsson (1972) figured a lobed hyphopodium of Gaeumannomyces graminis var. graminis in wheat leaf sheath tissue and Deverall, Wong and McLeod (1979) mentioned lobed hyphopodia of this fungus against the endodermis of invaded wheat roots. Occurrences of this type in tissue seem to be rare and their formation on the endodermis could be regarded as a surface phenomenon in an attempt (unsuccessful) to invade the stele. The structures formed internally in invaded roots of cereals and grasses and termed 'growth cessation structures' by Deacon (1974b) are not considered to be structures equivalent to hyphopodia and other superficial organs of infection. The former seem to develop as part of a halting or slowing down of infection in invaded roots. They show some variation in size, shape and arrangement between species, but whether these differences are constant enough to have taxonomic value requires further study (see Deacon, 1974b, 1980; Walker, 1980). Hyphopodia occur mainly on leaf and stem tissue although in the cereal fungi they have been seen on below ground organs such as the sub-crown internode (commonly) and roots (rarely). In some species, they have also been seen in culture.

As ability to form hyphopodia does not seem to be correlated with appressorium formation on germ tubes, and because hyphopodia are of taxonomic value in several groups of fungi, it is thought that the terms appressorium and hyphopodium should be kept separate. In the one species, it may seem strange to call structures on germ tubes appressoria and morphologically similar structures on vegetative hyphae hyphopodia. However, precision of expression, especially when discussing host-parasite relationships, requires that the two terms be separated. The general characters which distinguish these structures are set out below. The terms cannot possibly be rigidly defined as intermediate structures may occur but it is hoped that, with the discussion given above, they may be more logically applied.

Appressorium - a swelling, usually terminal, produced on germ tubes for attachment and penetration or terminally on a hypha within host tissue for cell wall penetration. All gradations from normal hyphae (which often penetrate host tissue) to complex structures occur (see Parbery and Emmett, 1977).

Hyphopodium - a cell or swelling produced from vegetative epiphytic hyphae for attachment and penetration. It may be terminal, lateral or intercalary (node cell), simple (Fig.51c) or lobed, hyaline or coloured, sessile or stalked (stigmatopodium or stigmopodium, with terminal stigmatocyst).

Infection cushion - a cluster of hyphae and hyphal cells under which multiple infections occur. In Gaeumannomyces graminis it represents a cluster of simple hyphopodia and, where it develops abundantly, is sometimes called plate mycelium (Fig.51f).

Node cell - an intercalary hyphopodium (Fig.51d and e).

Plate mycelium - layer of laterally fused simple hyphopodia causing multiple infections e.g. in the take-all and similar fungi on Gramineae (Fig.51f); see infection cushion.

Stigmatocyst (or stigmocyst) - the cell of a stalked hyphopodium from which the penetration peg develops (Fig.51a).

Stigmatopodium (or stigmopodium) - the stalk or short branch on which the penetration cell (stigmatocyst) is carried (Fig.51b). Defined by Arnaud (1918,p.41) as follows: 'Les cellules qui émettent des filaments

> perforant la cuticle sont parfois des cellules ordinaires; le plus souvent ce rôle est dévolu à des cellules spéciales (stigmocysts différenciés) qui sont, en génerál, portés sur des rameaux particuliers ou stigmopodies.'

In the host tissue, invasion from hyphopodia may be limited to formation of haustoria in host cells or may be more extensive.

SYNOPSIS OF FUNGI

The list includes all generic names, and all species listed in alphabetical order of specific epithet. In the case of a species in a genus not dealt with in detail in the text, it is listed under both its generic name and specific epithet. Accepted names are underlined;synonyms and names of doubtful status are not underlined.

Acanthophiobolus, see text
Acanthostigma gracile, syn. of Acanthophiobolus helicosporus
Acanthostigma helminthosporum, syn. Acanthophiobolus helicosporus
Acanthotheciella, see text
Acrospermum, see Cylindrina and Microstelium
A. parasiticum, see Cylindrina
acuminatus, Ophiobolus, earliest name for type species of Ophiobolus
alopecuri, Dilophospora, see Lidophia
alpinum, Lophodermium
andropogonis, Ophiobolus, exact identity not known
antarctica, Linospora, see Sphaerulina antarctica
antarctica, Sphaerulina
arenarius, Ophiobolus, now Plejobolus arenarius
arenarius, Plejobolus, see under Ophiobolus arenarius
arundinaceum, Lophodermium, type species of Lophodermium
arundinaceum var.alpinum, Lophodermium, now Lophodermium alpinum
Asteridiella knightiae, see note on hyphopodia and appressoria
Asterina, see note on hyphopodia and appressoria
Aureobasidium bolleyi, see under Phialophora radicicola
australiensis, Ophiobolus

barbata, Acanthotheciella, type species
barbata, Ophiochaeta, now Acanthotheciella barbata
barbatus, Ophiobolus, now Acanthotheciella barbata
Barya, see Microstelium
bhargavai, Plagiosphaera, a doubtful Plagiosphaera
bolleyi, Aureobasidium, see under Phialophora radicicola
bolleyi, Microdochium, see under Phialophora radicicola
brachysporus, Ophiobolus, syn. of Plagiosphaera immersa
brunellae, spelling error for prunellae (q.v.)
Buergenerula spartinae, see note on hyphopodia and appressoria

cajani, Linocarpon
capreae, Linospora, type species
cariceti, Linocarpon, see also Sphaeria cariceti
cariceti, Ophiobolus, see also Sphaeria cariceti

cariceti, Sphaeria, exact identity not determinable from type
caricis, *Gaeumannomyces*
Chaetomium, see under *Acanthophiobolus*
chaetophora, Ophiochaeta, syn. of *Acanthophiobolus* *helicosporus*
chaetophora, Ophiosphaeria, syn. of *Acanthophiobolus* *helicosporus*
chaetophora, Sphaeria, syn. of *Acanthophiobolus* *helicosporus*
chaetophorus, Ophiobolus, syn. of *Acanthophiobolus* *helicosporus*
cladii, Ophiochaeta, see under *Acanthophiobolus* *helicosporus*
Clasterosporium, see under *Gaeumannomyces* *caricis*
Cochliobolus, see text and under *Leptospora* and *Ophiobolus*; also see unplaced *Gaeumannomyces* specimens, under *Oryza*
coffeata, Sphaeria, type not traced, identity unknown
coffeatus, Ophiobolus, see Sphaeria coffeata
Colletotrichum spp., see note on hyphopodia and appressoria
compressa, *Leptosphaeria*
compressus, Ophiobolus, syn. of *Leptosphaeria* *compressa*; see also under Leptosporopsis
culmorum, Ophiobolus, see Sphaeria culmorum Crouan
culmorum Cke, Sphaeria, syn. of *Pleospora* *phaeocomoides* var. *infectoria*
culmorum Crouan, Sphaeria, identity not determinable from type
culmorum Wallr., Sphaeria, identity not known
Cylindrina, doubtful genus
cylindrosporus, *Gaeumannomyces*

delavayi, Cylindrina, exact identity unknown; genus doubtful
Dilophia, see *Lidophia*
Dilophospora *alopecuri*, see under *Lidophia*
Dinemasporium *graminum*, see list of unplaced *Gaeumannomyces* specimens, under *Poa*
disseminans, Ophiobolus, syn. of *Ophiobolus* *acuminatus*; type species of Ophiobolus
dolichostoma, Sphaeria, syn. of *Ophioceras* *dolichostomum*
dolichostomum, *Ophioceras*, type species of *Ophioceras*
doliolum, *Leptosphaeria*, type species of *Leptosphaeria*

elaeidis, *Linocarpon*
erikssonii, *Ophiosphaerella*
erythrospora, *Nodulosphaeria*, see under Ophiobolus pellitus
eucrypta, Sphaeria, see also *Gaeumannomyces* *caricis* and *G.* spp. on Cyperaceae
eucryptum, Linocarpon, see also *Gaeumannomyces* *caricis* and *G.* spp. on Cyperaceae
eucryptus, Ophiobolus, see also *Gaeumannomyces* *caricis* and *G.* spp. on Cyperaceae
Exilispora, see also under *Leptosphaeria*

falcatum, *Colletotrichum*, see note on hyphopodia and appressoria
filiforme, Ophioceras, see Schizacrospermum filiforme
filiforme, Schizacrospermum, identity doubtful
fragiformis, *Sphaeria*, see under Sphaeria

Gaeumannomyces, see text
Glomerella, see note on hyphopodia and appressoria

gracile, Acanthostigma)
gracilis, Acanthophiobolus, Lasiosphaeria,) syns. of
Ophiobolus, Ophiochaeta,) *Acanthophiobolus*
Ophiosphaeria) *helicosporus*
gramineum, *Lophodermium*
graminicola, *Colletotrichum*, see note on hyphopodia and appressoria
graminicola, Ophiobolus, syn. of *Ophiosphaerella graminicola*
graminicola, *Ophiosphaerella*, type species of *Ophiosphaerella*
graminicola, *Phialophora*, see also *Gaeumannomyces cylindrosporus*
'graminicolus ', Ophiobolus, error for Ophiobolus graminicola
graminis, Dilophia, syn. of *Lidophia graminis*
graminis, *Gaeumannomyces*
graminis, *Lidophia*
graminis, Ophiobolus, syn. of *Gaeumannomyces graminis* var. *graminis*
graminis, Ophiochaeta, syn. of *Gaeumannomyces graminis* var. *graminis*
graminis, Rhaphidophora, syn. of *Gaeumannomyces graminis* var. *graminis*
graminis, *Wojnowicia*, see *Triticum* specimen under *Gaeumannomyces graminis* var. *tritici*
graminis var. *avenae*, *Gauemannomyces*
graminis var. avenae, Ophiobolus, syn. of *Gaeumannomyces graminis* var. *avenae*
graminis var. *graminis*, *Gaeumannomyces*
graminis var. *tritici*, *Gaeumannomyces*
graminum, *Dinemasporium*, see list of unplaced *Gaeumannomyces* specimens, under *Poa*

halima, *Lulworthia*, see under Ophiobolus halimus
halimum, Linocarpon, see also under Ophiobolus halimus
halimus, Ophiobolus, now *Lulworthia halima*
helicospora, Sphaeria, syn. of *Acanthophiobolus helicosporus*
helicosporus, *Acanthophiobolus*
helicosporus, Ophiobolus, syn. of *Acanthophiobolus helicosporus*
helminthospora, 'Lasiosphaeria',) syns. of *Acanthophiobolus*
Leptospora, Ophiochaeta) *helicosporus*
helminthosporum, Acanthostigma, syn. of *Acanthophiobolus helicosporus*
helminthosporus, Acanthophiobolus, syn. of *Acanthophiobolus helicosporus*; type species of *Acanthophiobolus*
Hendersonia herpotricha, see under *Ophiosphaerella herpotricha*
herpotricha, Hendersonia, see under *Ophiosphaerella herpotricha*
herpotricha, Ophiochaeta, syn. of *Ophiosphaerella herpotricha*
herpotricha, *Ophiosphaerella*
herpotricha, Phaeosphaeria, Rhaphidophora,) syns. of *Ophiosphaerella*
Rhaphidospora, Sphaeria) *herpotricha*
herpotrichoides, *Phaeosphaeria*, see list of unplaced *Gaeumannomyces* specimens under *Poa*
'herpotrichus, Leptosporopsis', herbarium name; see Leptosporopsis
herpotrichus, Ophiobolus, syn. of *Ophiosphaerella herpotricha*; see also under Ophiochaeta and Leptosporopsis
hesperia, Leptosphaeria, see under Leptosporopsis
heterostrophus, *Cochliocolus*, see under Ophiobolus heterostrophus and *Ophiosphaerella herpotricha*
heterostrophus, Ophiobolus
hyalinum, Microstelium
Hypoxylon, see under Sphaeria

immersa, Plagiosphaera
immersus, Ophiobolus, syn. of Plagiosphaera immersa
implexa, Leptospora, see also under Ophiobolus tortilis
implexum, 'Ophioceras', see specimens under Leptospora implexa
implexum, Lophionema, syn. of Leptospora implexa
implexum, Lophiostoma, syn. of Leptospora implexa
implexus, Ophiobolus, syn. of Leptospora implexa
incompta, Ophiochaeta, exact identity not known
incompta, Rhaphidophora, see Ophiochaeta incompta; also under Acanthophiobolus
incomptus, Ophiobolus, see under Ophiochaeta incompta

junci, Ophiobolus, see also under Ophiosphaerella

knightiae, Asteridiella, see note on hyphopodia and appressoria
korrae, Leptosphaeria, see also note on hyphopodia and appressoria

Lasiosphaeria, see text
Lejosphaerella, see list of unplaced Gaeumannomyces specimens under Glyceria
leptosperma, Ophiosphaerella
leptosperma, Rhaphidophora, syn. of Ophiosphaerella leptosperma
leptosperma, Rhaphidospora, syn. of Ophiosphaerella leptosperma
leptospermus, Ophiobolus, syn. of Ophiosphaerella leptosperma
Leptosphaeria, see text and also under Gaeumannomyces spp. on Cyperaceae, and Lidophia
Leptosphaeriopsis, see text
Leptospora, see text and also under Gaeumannomyces spp. on Cyperaceae, and Ophiobolus leptosporus
Leptosporopsis, not validly published
leptosporum, Ophioceras
leptosporus, Gaeumannomyces, syn. of Ophioceras leptosporum
leptosporus, Ophiobolus, exact identity unknown
licualae, Ophiobolus, see also under Linocarpon
Lidophia, see text
Linocarpon, see text
Linospora, see text
littoralis Cribb & Cribb, Ophiobolus, see Ophiobolus australiensis
littoralis (Crouan) Sacc., Ophiobolus, see Sphaeria littoralis
littoralis, Sphaeria, exact identity unknown
livistonae, Linocarpon, see also under Ophiobolus livistonae
livistonae, Ophiobolus, see also under Linocarpon livistonae
Lophiostoma, see under Leptospora implexa
Lophodermium, see text
Lulworthia, see text

magellanica, Linospora, syn. of Lophodermium magellanicum
magellanicum, Lophodermium
Magnaporthe salvinii, see note on hyphopodia and appressoria,and list of unplaced Gaeumannomyces specimens, under Oryza
manihotis, Linocarpon, see under Ophiobolus manihotis

manihotis, Ophiobolus, exact identity not known
maritima, Rhaphidophora, type sterile; see under Ophiobolus maritimus
maritimum, Linocarpon, see under Ophiobolus maritimus
maritimus, Ophiobolus, type sterile; exact identity not known
maydicus, *Pithomyces*, see list of specimens under *Ophiobolus* sp.
medusae, Linocarpon, see also under *Lulworthia*
medusae, *Lulworthia*
medusae, Ophiobolus, see also under *Lulworthia* and Ophiobolus andropogonis
medusae f. bromi, Ophiobolus, syn. of *Ophiosphaerella herpotricha*
medusae var. minor, Ophiobolus, exact identity not known; see under Ophiobolus andropogonis and *Ophiosphaerella herpotricha*
Meliola panici, see under Ophiobolus stipae
michotii, *Paraphaeosphaeria*, see list of unplaced *Gaeumannomyces* specimens under Gramineae undet.
Microdochium bolleyi, see under Phialophora radicicola
Microstelium, doubtful genus
moravica, Plagiosphaera, syn. of *Plagiosphaera immersa*; type species of *Plagiosphaera*
(For further "m" names, see Addendum at end of paper)

Nakatea sigmoidea, see note on hyphopodia and appressoria
narmari, *Leptosphaeria*, see also note on hyphopodia and appressoria
nipae, Linocarpon, see also under Ophiobolus nipae
nipae, Ophiobolus, see also under Linocarpon nipae
Nodulosphaeria, see under Sphaeria penicillus
Nodulosphaeria erythrospora, see under Ophiobolus pellitus

oedema, Ophiobolus, see also under *Linocarpon*
oedema, Rhaphidospora, see also under Ophiobolus oedema
oedema, Sphaeria, see also under Ophiobolus oedema
ophioboloides, Leptosphaeria, syn. of *Ophiobolus ophioboloides*
ophioboloides, Leptosphaeriopsis, syn. of *Ophiobolus ophioboloides*
ophioboloides, *Ophiobolus*
Ophiobolus, see text
Ophioceras, see text
Ophiochaeta, see discussion; a syn. of *Acanthophiobolus*
Ophiosphaerella, see text
Ophiosphaeria, syn. of *Acanthophiobolus*
Ophiotrichia, not validly published
oryzae, Ophiobolus, see also under *Ophiosphaerella herpotricha*
oryzae, *Phaeosphaeria*, type species of *Phaeosphaeria*
oryzae, *Pyrenochaeta*, see list of unplaced *Gaeumannomyces* specimens, under *Oryza*
oryzinum, Linocarpon, syn. of *Gaeumannomyces graminis* var. *graminis*
oryzinus, Gaeumannomyces, invalid; syn. of *Gaeumannomyces graminis* var. *graminis*
oryzinus, Ophiobolus, syn. of *Gaeumannomyces graminis* var. *graminis*

palmetto, *Linocarpon*
palmetto, Linospora, syn. of *Linocarpon palmetto*
paludosa, Leptosphaeria, see under *Gaeumannomyces* spp. on Cyperaceae
paludosus, Ophiobolus, see under *Gaeumannomyces* spp. on Cyperaceae
pandani, *Linocarpon*, type species of *Linocarpon*

pandani Rehm, Linospora, syn. of Linocarpon pandani
pandani H. & P. Syd., Linospora, syn. of Linocarpon pandani
panici, Meliola, see under Ophiobolus stipae
Paraphaeosphaeria michotii, see list of unplaced Gaeumannomyces specimens, under Gramineae undet.
parasiticum, Acrospermum, see under Cylindrina
pedicellata, Sphaerulina, see note on hyphopodia and appressoria
pellitus, Ophiobolus
penicillus, Ophiobolus, see also under Sphaeria penicillus
penicillus, Ophiochaeta, see also under Sphaeria penicillus
penicillus, Sphaeria, see also discussion under Ophiochaeta
phaeocomoides var. infectoria, Pleospora, see under Sphaeria culmorum Cke
Phaeosphaeria, see text; also list of specimens under Ophiobolus sp. and O. stipae
Phaeosphaeria herpotrichoides, see list of unplaced Gaeumannomyces specimens under Poa, and note on hyphopodia and appressoria
Phialophora, see text and also under Gaeumannomyces
Pithomyces maydicus, see list of specimens under Ophiobolus sp.
Plagiosphaera, see text
platensis, Plagiosphaera
platensis, 'Trichospermella', herbarium name; see Plagiosphaera platensis
platensis, Winterella, syn. of Plagiosphaera platensis
Plejobolus arenarius, see under Ophiobolus arenarius
Pleospora, see list of unplaced Gaeumannomyces specimens, under Gramineae undet.
Pleospora phaeocomoides var. infectoria, see under Sphaeria culmorum Cke
Pleuroceras, see under Plagiosphaera quercicola
plurisepta, Exilispora, syn. of Leptosphaeria compressa
plurisepta, Leptosphaeria, see Exilispora and Leptosphaeria compressa
porphyrogonus, Ophiobolus, see under Ophiobolus leptosporus
prunellae, 'Leptosporopsis',) see discussion under
Linospora, Ophiobolus) Leptosporopsis
pulchella, Linospora, syn. of Gaeumannomyces graminis var. graminis
pulchella, Trichospermella, type species of Trichospermella; see under Plagiosphaera platensis
Pyrenochaeta oryzae, see list of unplaced Gaeumannomyces specimens under Oryza

quercicola, Plagiosphaera, exact identity doubtful

raciborskii, Lasiosphaeria
raciborskii, Ophiochaeta, syn. of Lasiosphaeria raciborskii
radicicola, Phialophora, confused name
radicicola var. graminicola, Phialophora, syn. of Phialophora graminicola
radicicola var. radicicola, Phialophora, confused name
Rhaphidophora, later homonym; see text
Rhaphidospora, later homonym; see text
Rhizoctonia solani, see note on hyphopodia and appressoria
rostrupii, 'Leptosporopsis';, see under Leptosporopsis
rostrupii, Ophiobolus, see also under Leptosporopsis
rubella, Leptospora, type species of Leptospora

rubellus, Ophiobolus, see also *Leptospora rubella*
rubra (Fragi similis), Sphaeria

salinus, Ophiobolus, new name for Ophiobolus medusae var. minor; see under Ophiobolus andropogonis
salvinii, *Magnaporthe*, see note on hyphopodia and appressoria and list of unplaced *Gaeumannomyces* specimens, under *Oryza*
Schizacrospermum, exact identity not known
Scolecosporiella, see under *Ophiosphaerella herpotricha*
sigmoidea, *Nakatea*, see note on hyphopodia and appressoria
solani, *Rhizoctonia*, see note on hyphopodia and appressoria
sorghi, Ophioceras, exact identity uncertain
sp.(lobed hyphopodia), *Phialophora*
spartinae, *Buergenerula*, see note on hyphopodia and appressoria
Sphaeria, see text
Sphaeropsidales, undetermined, see list of unplaced *Gaeumannomyces* specimens, under *Oryza*
Sphaerulina, see text; also under Ophioceras zeae
Sphaerulina pedicellata, see note on hyphopodia and appressoria
spirosporus, Ophiobolus
Stictis, see under Cylindrina and Ophiobolus stictisporus
stictispora, Sphaeria, see Ophiobolus stictisporus
stictisporus, Ophiobolus
stipae, Linocarpon, syn. of *Ophiosphaerella stipae*
stipae, Ophiobolus, exact identity uncertain; see also under *Ophiosphaerella*
stipae, *Ophiosphaerella*
'strictisporus', Ophiobolus, spelling error for stictisporus (q.v.)
'subantarctica', Linospora, herbarium name; see *Sphaerulina antarctica*

tanaceti, *Leptosphaeria*
tanaceti, Ophiobolus, syn. of *Leptosphaeria tanaceti*; see also under Leptosporopsis
tax sp. 1, *Gaeumannomyces*, on Cyperaceae
tax sp. 2, *Gaeumannomyces*, now *Gaeumannomyces caricis*
tax sp. 3, *Gaeumannomyces*, on Cyperaceae
tenella, Ophiosphaeria, syn. of *Acanthophiobolus helicosporus*
tortilis, Ophiobolus, exact identity unknown
'trechisporus', Ophiobolus, spelling error for trichisporus
trichella, Ophiochaeta, exact identity unknown; see also under Ophiobolus
trichellus, Ophiobolus, exact identity unknown; see also under Ophiochaeta
trichisporus, Ophiobolus, syn. of *Leptospora rubella*
'Trichospermella' platensis, herbarium name; see *Plagiosphaera platensis*
Trichospermella pulchella, type species of *Trichospermella*; see under *Plagiosphaera platensis*
'trichosporus', Ophiobolus, spelling error for trichisporus

umbelliferarum, Linocarpon, syn. of *Plagiosphaera umbelliferarum*
umbelliferarum, *Plagiosphaera*, see also under *Ophioceras leptosporum*
Urohendersoniella, see under *Ophiosphaerella herpotricha*

vagans, *Phaeosphaeria*, see under *Ophiosphaerella*
verminosa, Rhaphidophora, see under Ophiobolus verminosus
verminosa, Sphaeria, see under Ophiobolus verminosus
verminosum, Linocarpon, see under Ophiobolus verminosus
verminosus, Ophiobolus
versisporum, *Linocarpon*
versisporus, Ophiobolus, syn. of *Linocarpon* *versisporum*
verrucosa, *Phialophora*, type species of *Phialophora*

williamsii, Linocarpon, syn. of *Ophiosphaerella* *williamsii*
williamsii, *Ophiosphaerella*
Winterella, see also under *Plagiosphaera* *platensis*

Ypsilonia, see under *Acanthotheciella*

'zeae, Cochliobolus', see under Ophiobolus zeae
zeae, Ophiobolus, syn. of *Ophiosphaerella* *herpotricha*
zeae, Ophioceras, exact identity unknown

HOST AND SUBSTRATE INDEX

The hosts are listed in alphabetical order under families and the fungi recorded on each species noted. The list includes all specimens examined and also host-parasite associations noted in the literature when these are mentioned in the text. These literature records are marked (L) and, as specimens have not been seen, their accuracy cannot be verified here. The name '*Ophiobolus graminis*' in the list refers to unplaced specimens listed under *Gaeumannomyces* or to literature records of take-all where the variety of *G*. *graminis* cannot be determined.

- ARALIACEAE
  - Heptapleurum venulosum
    - Acrospermum parasiticum (L)

- AVICENNIACEAE
  - Avicennia sp.
    - Ophiobolus australiensis (L)

- CAPRIFOLIACEAE
  - Lonicera quinquelocularis
    - Plagiosphaera bhargavai (L)

- COMPOSITAE
  - Artemisia austriaca
    - Leptosphaeria compressa
  - Cirsium arvense
    - Ophiobolus acuminatus
  - Erechtites prenanthoides
    - Leptospora rubella
  - Erigeron sp.
    - Leptosphaeria compressa

- CYPERACEAE
  - Carex acutiformis
    - Acanthophiobolus helicosporus
    - Gaeumannomyces caricis
    - Gaeumannomyces tax.sp.1
  - Carex elata
    - Acanthophiobolus helicosporus
    - Sclerotia and lobed hyphopodia
  - Carex paniculata
    - Acanthophiobolus helicosporus
    - Gaeumannomyces caricis
  - Carex pendula
    - Acanthophiobolus helicosporus
    - 'Sphaeria eucrypta' (L)
  - Carex pseudocyperus
    - Gaeumannomyces tax. sp.1
  - Carex riparia
    - Acanthophiobolus helicosporus
    - Gaeumannomyces tax. sp.1
  - Carex vesicaria
    - Leptosphaeria paludosa (L)
  - Carex sp. (aff. C.bichenoviana)
    - Sclerotia and lobed hyphopodia

- Carex sp.
  - Gaeumannomyces tax. sp.1
- Carpha schoenoides
  - Sphaerulina antarctica
- Cladium mariscus
  - Acanthophiobolus helicosporus
  - Ophiochaeta cladii (L)
- Lepidosperma sp.
  - Acanthophiobolus helicosporus
- Scirpus lacustris
  - Sphaeria culmorum Wallr. (L)
- Scirpus sp.
  - Ophiosphaerella leptosperma
- Undetermined
  - Acanthophiobolus helicosporus
  - Gaeumannomyces tax. sp. 3

FAGACEAE

- Quercus glauca
  - Plagiosphaera sp. (L)
- Quercus salicina
  - Plagiosphaera quercicola (L)

GRAMINEAE

- Agropyron scabrum
  - 'Ophiobolus graminis'
- Agrostis palustris
  - Gaeumannomyces graminis var. avenae
- Agrostis stolonifera
  - Gaeumannomyces graminis var. avenae
- Agrostis tenuis
  - Gaeumannomyces graminis var. avenae
  - Phialophora graminicola
- Agrostis sp.
  - Gaeumannomyces graminis var. avenae
- Ammophila arenaria
  - Ophiobolus trichellus (L)
  - Plejobolus arenarius (L)
- Andropogon muricatus
  - see under Vetiveria zizanioides
- Andropogon sp.
  - Leptospora implexa (L)
- Aristida sp.
  - Gaeumannomyces graminis var. graminis
- Avena byzantina
  - Gaeumannomyces graminis var. tritici
- Avena fatua
  - Gaeumannomyces graminis var. tritici
- Avena sativa
  - Gaeumannomyces graminis var. avenae
  - Gaeumannomyces graminis var. graminis
  - Gaeumannomyces graminis var. tritici
- 'Axonopus africanus'
  - Ophiosphaerella herpotricha
- Axonopus compressus
  - Gaeumannomyces graminis var. graminis
- Axonopus sp.
  - Gaeumannomyces graminis var. graminis
- Bromus inermis
  - Ophiosphaerella herpotricha
- Bromus sterilis
  - Gaeumannomyces graminis var. tritici
- Bromus unioloides
  - Gaeumannomyces graminis var. graminis
  - Lophodermium gramineum
  - Phialophora graminicola
- Bromus vulgaris
  - Gaeumannomyces graminis var. tritici
  - 'Ophiobolus graminis'
- Calamagrostis neglecta
  - Ophiosphaerella erikssonii
- Chloris gayana
  - Gaeumannomyces graminis var. graminis
  - Ophiosphaerella herpotricha (immature)
- Chrysopogon sp.
  - Ophiosphaerella sp.
- Cynodon dactylon
  - Gaeumannomyces graminis var. graminis
  - Ophiobolus sp. (L)
- Deschampsia bottnica
  - Gaeumannomyces graminis var. avenae
- Deschampsia danthonioides
  - Gaeumannomyces graminis var. avenae
  - 'Ophiobolus graminis'
- Echinochloa crus-galli
  - Ophiosphaerella herpotricha
- Elymus sp.
  - Lophodermium alpinum (L)
- Festuca purpurascens
  - Lophodermium magellanicum

- Festuca subulata
  - 'Ophiobolus graminis'
- Festuca sp.
  - Lophodermium alpinum (L)
- Glyceria maxima
  - Acanthophiobolus helicosporus
  - Lejosphaerella
  - 'Ophiobolus graminis'
- Glyceria spectabilis
  - Acanthophiobolus helicosporus (L)
- Holcus sp.
  - Gaeumannomyces graminis var. avenae
- Hordeum vulgare
  - Gaeumannomyces graminis var. tritici
  - Microdochium bolleyi (L)
  - 'Ophiobolus graminis'
  - Phialophora sp. (lobed hyphopodia)
- Leptochloa virgata
  - Ophiosphaerella graminicola
- Lolium perenne
  - Phialophora graminicola
- Microlaena stipoides
  - Gaeumannomyces graminis var. graminis
- Molinia japonica
  - Gaeumannomyces graminis var. graminis
- Nardus stricta
  - Lophodermium alpinum (L)
- Oryza sativa
  - Cochliobolus sp.
  - Gaeumannomyces graminis var. graminis
  - Gaeumannomyces graminis var. tritici
  - 'Ophiobolus graminis'
  - Ophiobolus sp. (L)
  - Ophiosphaerella herpotricha
  - Pyrenochaeta oryzae
  - Sclerotia undet.
  - Sphaeropsidales undet.
- Panicum curtisii
  - 'Ophiobolus graminis'
- Panicum maximum
  - Leptospora implexa
- Paspalidium geminatum
  - 'Ophiobolus graminis'
- Paspalidium sp.
  - Gaeumannomyces graminis var. graminis
- Pennisetum americanum
  - 'Ophiobolus graminis'
- Pennisetum clandestinum
  - Gaeumannomyces graminis var. graminis
- Phalaris aquatica
  - 'Ophiobolus graminis'
- Phalaris arundinacea
  - Leptosphaeria paludosa (L)
- Phalaris minor
  - 'Ophiobolus graminis'
- Phalaris sp.
  - Gaeumannomyces graminis var. graminis
- Phragmites australis
  - Acanthophiobolus helicosporus
- Poa aquatica
  - see Glyceria maxima
- Poa pratensis
  - Dinemasporium graminum
  - 'Ophiobolus graminis'
  - Phaeosphaeria herpotrichoides
- Psamma arenaria
  - see Ammophila arenaria
- Pucciniella sp.
  - Lophodermium alpinum (L)
- Saccharum spontaneum
  - Ophiobolus spirosporus
- Sasa kurilensis
  - Plagiosphaera muroiana
- Secale cereale
  - Phialophora sp.(lobed hyphopodia)
- Sorghum halepense
  - Leptospora implexa
  - 'Ophiobolus graminis' (L)
- Sorghum vulgare
  - 'Ophiobolus graminis (L)
  - Ophiobolus leptosporus (L)
  - Ophioceras sorghi (L)
- Spartina sp.
  - Lulworthia medusae
- Stipa aristiglumis
  - Gaeumannomyces graminis var. graminis
- Stipa dregeana
  - Meliola panici
  - Ophiobolus stipae
- Stipa sp.
  - Ophiosphaerella stipae
- Trisetum cernuum
  - 'Ophiobolus graminis'
- Triticum aestivum
  - Gaeumannomyces cylindrosporus
  - Gaeumannomyces graminis var. avenae
  - Gaeumannomyces graminis var. graminis

Gaeumannomyces graminis
        var. tritici
    'Ophiobolus graminis'
    Phialophora graminicola (L)
    Wojnowicia graminis
  Vetiveria zizanioides
    Ophiobolus andropogonis (L)
    Ophiobolus medusae var.
        minor (L)
    Ophiobolus tortilis (L)
    Ophiosphaerella herpotricha
  Vulpia bromoides
    'Ophiobolus graminis'
  Zea mays
    'Ophiobolus graminis' (L)
    Ophioceras zeae (L)
    Ophiosphaerella herpotricha
    Phaeosphaeria sp.
    Phialophora radicicola Cain
    Phialophora sp. (lobed
        hyphopodia)
    Pithomyces aff. maydicus
  Zizania aquatica
    Gaeumannomyces graminis
        var. graminis
  Zostera marina
    Lulworthia halima (L)
  Gramineae (Cynodon or Agropyron)
    Gaeumannomyces graminis
        var. graminis
  Undetermined Gramineae
    Leptospora rubella
    Lidophia graminis
    Mycosphaerella sp.
    'Ophiobolus graminis'
    Ophiosphaerella herpotricha
    Ophiosphaerella williamsii
    Paraphaeosphaeria michotii
    Phialophora graminicola
    Phialophora spp.
    Pleospora sp.

GROSSULARIACEAE
  Ribes sp.
    Ophiochaeta incompta (L)

IRIDACEAE
  Iris foetidissima
    Plagiosphaera sp.
  Iris pseud'acorus
    Acanthophiobolus helicosporus

JUNCACEAE
  'Juncus laevis'
    Sphaeria culmorum Wallr. (L)
  Juncus subnodulosus
    Acanthophiobolus helicosporus
  Juncus sp.
    Ophiobolus junci (L)

ORCHIDACEAE
  Liparis liliiflora
    Cylindrina delavayi

PALMAE
  Elaeis guineensis
    Linocarpon cajani (L)
    Linocarpon elaeidis
  Livistona sp.
    Ophiobolus livistonae
  Mauritia flexuosa
    Ophiobolus oedema
  Sabal spp.
    Linocarpon palmetto (L)
    Ophiobolus versisporus (L)
  Undetermined
    Ophiobolus licualae (L)
    Ophiobolus nipae (L)
    Ophiobolus verminosus (L)

PANDANACEAE
  Pandanus laevis
    Linocarpon pandani
  Pandanus sabotan
    Linocarpon pandani
  Pandanus utilissimus
    Linocarpon pandani

PAPILIONACEAE
  Cajanus cajan
    Linocarpon cajani
  Glycine max
    Gaeumannomyces graminis
        var. graminis

PHYTOLACCACEAE
  Phytolacca dioica
    Plagiosphaera platensis

RANUNCULACEAE
  Aconitum napellus
    Plagiosphaera immersa

SALICACEAE
  Salix sp.
    Linospora capreae (L)

TYPHACEAE
  Typha latifolia
    Gaeumannomyces graminis
        var. graminis (L)

UMBELLIFERAE
  Heracleum lanatum
    Plagiosphaera umbelliferarum
  Undetermined
    Ophioceras leptosporum

URTICACEAE
  Urtica dioica
    Plagiosphaera immersa

ZINGIBERACEAE
  Amomum sp.
    Schizacrospermum filiforme

Dead scale insects on branches
  Acanthotheciella barbata

Bark
  Microstelium hyalinum

Cloth
  Acanthophiobolus helicosporus

Leaves, waterlogged
  Ophioceras leptosporum

Stems, herbaceous
  Sphaeria penicillus

Wood, waterlogged
  Ophioceras dolichostomum (L)

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ADDENDUM

The following "m" names were inadvertently omitted from the Synopsis of Fungi and should be added:-

moravicus, Ophiobolus, syn. of *Plagiosphaera immersa*
muroiana, *Plagiosphaera*
muroianum, Linocarpon, syn. of *Plagiosphaera muroiana*
mutabilis, *Phialophora*, see under *Phialophora*
Mycosphaerella, see list of unplaced *Gaeumannomyces* species, under Gramineae undet.
myriadea, *Sphaerulina*, type species of *Sphaerulina*

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GENERIC DELIMITATION IN THE LICHEN FAMILY THELOTREMATACEAE

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ABSTRACT

Three genera in the lichen family Thelotremataceae, Thelotrema *Ach.,* Myriotrema *Fée, and* Ocellularia *Meyer, are delimited on the basis of excipular structure and new combinations for 135 species are made.*

The lichen family Thelotremataceae is a largely tropical group of about 450 species. There are four spore types, colorless-transversely septate, brown-transversely septate, colorless-muriform, and brown-muriform, which J. Müller Argoviensis (1887) recognized as four distinct genera: *Ocellularia* Meyer, *Phaeotrema* Müll. Arg., *Thelotrema* Ach., and *Leptotrema* Mont. & v. d. Bosch, respectively. Most lichenologists have in fact adopted these "spore genera." At the same time, when the species are examined without reference to spore characters, one finds significant differences in excipular structure, unrelated to spore septation and pigmentation, which Salisbury (1971, 1972, 1978) has recently argued to be a more natural basis for generic classification in the family. His conclusions follow logically from the increased emphasis being given to ontogenetic characters at both the generic and family level (Henssen & Jahns, 1974).

Salisbury recognizes one genus (*Thelotrema*), which he subdivides into three sections, reflecting the nature of the exciple: sect. *Thelotrema* (exciple colorless, with periphysoids), sect. *Myriotrema* (Fée) G. Salisbury (exciple colorless, without periphysoids), and sect. *Ascidium* (Fée) G. Salisbury (exciple carbonized, without periphysoids). While the four spore genera are more or less equally represented in each of these sections (much as the three excipular types are represented in each of the spore genera), an alignment according to exciple is obviously a more natural one since it places in close proximity species with identical apothecial and cortical structure and chemistry, even though the spores are different. By using spores the same species are dispersed in widely separated genera.

I propose to recognize the three main excipular types at the generic level, much as Fée had unwittingly done in 1824, although his classification was not adopted by any later workers. Thus, *Thelotrema* sect. *Thelotrema* becomes *Thelotrema*, sect. *Myriotrema Myriotrema*, and sect. *Ascidium Ocellularia*. These three genera are amply distinguished by the excipular structures as well as correlating anatomical and chemical characters (Hale, 1981) with virtually no intermediate states, providing a convenient breakdown of the 450 species known at the world level.

Many species described in *Ocellularia* and *Thelotrema* or transferred to these genera on the basis of spore characters are in fact already correctly recognized in the new generic delimitation. However, a number of species must be transferred to *Myriotrema*, which no authors since Fée have accepted, and all species formerly classified under the brown-spored genera *Leptotrema* and *Phaeotrema* must be transferred to the appropriate excipular genera. The following 135 new combinations are being made here for species which I have already examined and typified (Hale, 1973, 1974a, 1974b, 1975, 1978a, 1978b). Full synonymy and more detailed discussions of the genera will be presented in another article (Hale, 1981).

THELOTREMA

Thelotrema Ach., Meth. Lich. 130 (1803).
Type species: *Lichen lepadinus* Ach.
Thelotrema sect. *Thelotrema*
Number of species: 100

Thelotrema africanum (Hale) Hale, comb. nov.
Basionym: *Leptotrema africanum* Hale, Mycotaxon 7:382 (1978).
Thelotrema aggregatum (Hale) Hale, comb. nov.
Basionym: *Phaeotrema aggregatum* Hale, Smith. Contr. Bot. 16:29 (1974).
Thelotrema astroideum (Berk. & Broome) Hale, comb. nov.
Basionym: *Platygrapha astroidea* Berk. & Broome, J. Linn. Soc. 14:109 (1875).
Thelotrema coccineum (Leight.) Hale, comb. nov.
Basionym: *Platygrapha coccinea* Leight. Trans. Linn. Soc. 25:456 (1866).
Thelotrema dilatatum (Müll. Arg.) Hale, comb. nov.
Basionym: *Ocellularia dilatata* Müll. Arg. J. Linn. Soc., Bot. 30:452 (1895).
Thelotrema dissutum (Hale) Hale, comb. nov.
Basionym: *Ocellularia dissuta* Hale, Smith. Contr. Bot. 38:20 (1978).
Thelotrema esslingeri (Hale) Hale, comb. nov.
Basionym: *Ocellularia esslingeri* Hale, Smith. Contr. Bot. 38:20 (1978).
Thelotrema hawaiiense (Hale) Hale, comb. nov.
Basionym: *Leptotrema hawaiiense* Hale, Phytol. 27:490 (1974).
Thelotrema hypoprotocetraricum (Hale) Hale, comb. nov.
Basionym: *Leptotrema hypoprotocetraricum* Hale, Smith. Contr. Bot. 38:52 (1978).
Thelotrema kamatii (Patw. & Kulk.) Hale, comb. nov.
Basionym: *Ocellularia kamatii* Patw. & Kulk. Norw. J. Bot. 24:130 (1977).
Thelotrema leprieurii (Mont.) Hale, comb. nov.
Basionym: *Stictis leprieurii* Mont. Ann. Sci. Nat. Bot., sér. 4, 3:97 (1855).
Thelotrema magnificum (Berk. & Broome) Hale, comb. nov.
Basionym: *Platygrapha magnifica* Berk. & Broome, J. Linn. Soc.

14:110 (1875).

Thelotrema mirabile (Zahlbr.) Hale, comb. nov.
Basionym: *Phaeographina mirabilis* Zahlbr. in Handel-Mazzetti, Symb. Sin. 3:60 (1930).

Thelotrema neei (Hale) Hale, comb. nov.
Basionym: *Ocellularia neei* Hale, Smith. Contr. Bot. 38:25 (1978).

Thelotrema phlyctidioides (Müll. Arg.) Hale, comb. nov.
Basionym: *Ocellularia phlyctidioides* Müll. Arg. Hedw. 32:130 (1893).

Thelotrema pseudoexanthismocarpum (Patw. & Kulk.) Hale, comb. nov.
Basionym: *Ocellularia pseudoexanthismocarpa* Patw. & Kulk. Norw. J. Bot. 24:130 (1977).

Thelotrema pseudoschizostomum (Hale) Hale, comb. nov.
Basionym: *Ocellularia pseudoschizostoma* Hale, Smith. Contr. Bot. 38:28 (1978).

Thelotrema refertum (Hale) Hale, comb. nov.
Basionym: *Ocellularia referta* Hale, Smith. Contr. Bot. 38:29 (1978).

Thelotrema rockii (Zahlbr.) Hale, comb. nov.
Basionym: *Phaeotrema rockii* Zahlbr. Ann. Mycol. 10:370 (1912).

Thelotrema stellatum (Hale) Hale, comb. nov.
Basionym: *Leptotrema stellatum* Hale, Smith. Contr. Bot. 38:54 (1978).

Thelotrema turgidulum (Müll. Arg.) Hale, comb. nov.
Basionym: *Ocellularia turgidula* Müll. Arg. J. Botanique 7:94 (1893).

MYRIOTREMA

Myriotrema Fée, Essai Crypt. 103 (1824).
Type species: *Myriotrema olivaceum* Fée
Thelotrema sect. *Myriotrema* (Fée) G. Salisbury
Number of species: 150

Myriotrema albidulum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema albidulum* Nyl. Ann. Sci. Nat. Bot., sér 4, 15:46 (1861).

Myriotrema anamalaiense (Patw. & Kulk.) Hale, comb. nov.
Basionym: *Thelotrema anamalaiense* Patw. & Kulk. Norw. J. Bot. 24:127 (1977).

Myriotrema andamanicum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema andamanicum* Nyl. Bull. Soc. Linn. Normandie, sér. 2, 7:167 (1873).

Myriotrema bahianum (Ach.) Hale, comb. nov.
Basionym: *Thelotrema lepadinum* var. *bahianum* Ach. Meth. Lich. 132 (1803).

Myriotrema barroense (Hale) Hale, comb. nov.
Basionym: *Ocellularia barroensis* Hale, Smith. Contr. Bot. 38:14 (1978).

Myriotrema calvescens (Fée) Hale, comb. nov.
Basionym: *Thelotrema calvescens* Fée, Essai Crypt. Suppl. 89 (1837).

Myriotrema cinereoglaucescens (Vain.) Hale, comb. nov.
Basionym: *Thelotrema cinereoglaucescens* Vain. Suomal. Tiedeakat. Toim., ser. A, 15:189 (1921).

Myriotrema cinereum (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema cinereum* Müll. Arg. Flora 74:112 (1891).

Myriotrema clandestinum (Fée) Hale, comb. nov.
Basionym: *Thelotrema clandestinum* Fée, Essai Crypt. Suppl. 90 (1837).
Myriotrema compunctum (Ach.) Hale, comb. nov.
Basionym: *Urceolaria compuncta* Ach. Meth. Lich. 143 (1803).
Myriotrema concretum (Fée) Hale, comb. nov.
Basionym: *Thelotrema concretum* Fée, Essai Crypt. Suppl. 90 (1837).
Myriotrema configuratum (Hale) Hale, comb. nov.
Basionym: *Ocellularia configurata* Hale, Smith. Contr. Bot. 38:17 (1978).
Myriotrema congestum (Hale) Hale, comb. nov.
Basionym: *Ocellularia congesta* Hale, Smith. Contr. Bot. 38:17 (1978).
Myriotrema costaricense (Müll. Arg.) Hale, comb. nov.
Basionym: *Ocellularia costaricensis* Müll. Arg. Bull. Soc. Roy. Bot. Belg. 30:75 (1891).
Myriotrema dactyliferum (Hale) Hale, comb. nov.
Basionym: *Ocellularia dactylifera* Hale, Smith. Contr. Bot. 38:19 (1978).
Myriotrema deceptum (Hale) Hale, comb. nov.
Basionym: *Leptotrema deceptum* Hale, Smith. Contr. Bot. 16:39 (1978).
Myriotrema desquamans (Müll. Arg.) Hale, comb. nov.
Basionym: *Anthracothecium desquamans* Müll. Arg. Flora 71:48 (1888).
Myriotrema elachistoteron (Leight.) Hale, comb. nov.
Basionym: *Thelotrema elachistoteron* Leight. Trans. Linn. Soc. Lond. 27:169 (1870).
Myriotrema eminens (Hale) Hale, comb. nov.
Basionym: *Thelotrema eminens* Hale, Mycotaxon 3:177 (1975).
Myriotrema exile (Hale) Hale, comb. nov.
Basionym: *Thelotrema exile* Hale, Mycotaxon 7:381 (1978).
Myriotrema foliicola (Hale) Hale, comb. nov.
Basionym: *Phaeotrema foliicola* Hale, Mycotaxon 3:175 (1975).
Myriotrema fragile (Hale) Hale, comb. nov.
Basionym: *Ocellularia fragilis* Hale, Phytol. 27:492 (1974).
Myriotrema glaucescens (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema glaucescens* Nyl. Ann. Sci. Nat. Bot., sér. 4, 19:332 (1863).
Myriotrema glaucophaenum (Kremplh.) Hale, comb. nov.
Basionym: *Thelotrema glaucophaenum* Kremplh. Nuov. G. Bot. Ital. 7:19 (1875).
Myriotrema glauculum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema glauculum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:332 (1863).
Myriotrema granulosum (Leight.) Hale, comb. nov.
Basionym: *Ascidium granulosum* Leight. Trans. Linn. Soc. Lond. 27:171 (1870).
Myriotrema halei (Tuck.) Hale, comb. nov.
Basionym: *Porina halei* Tuck. & Mont. in Mont. Ann. Sci. Nat. Bot., sér. 4, 8:295 (1857).
Myriotrema hartii (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema hartii* Müll. Arg. Flora 69:311 (1886).
Myriotrema immersum (Eschw.) Hale, comb. nov.
Basionym: *Thelotrema immersum* Eschw. in Mart. Fl. Bras. 1:177 (1833).
Myriotrema insigne (Zahlbr.) Hale, comb. nov.
Basionym: *Thelotrema insigne* Zahlbr. Denkschr. Math.-nat. Cl.

Myriotrema laeviusculum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema laeviusculum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:335 (1863).
Myriotrema leiostomum (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema leiostomum* Tuck. Proc. Amer..Acad. Arts Sci. 5:407 (1862).
Myriotrema mammiculum (Hale) Hale, comb. nov.
Basionym: *Leptotrema mammiculum* Hale, Mycotaxon 7:382 (1978).
Myriotrema mammilare (Hale) Hale, comb. nov.
Basionym: *Phaeotrema mammilare* Hale, Phytol. 27:494 (1974).
Myriotrema masonhalei (Patw. & Kulk.) Hale, comb. nov.
Basionym: *Thelotrema masonhalei* Patw. & Kulk. Norw. J. Bot. 24:128 (1977).
Myriotrema maximum (Hale) Hale, comb. nov.
Basionym: *Thelotrema maximum* Hale, Smith. Contr. Bot. 38:45 (1978).
Myriotrema microporellum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema microporellum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:327 (1863).
Myriotrema microporum (Mont.) Hale, comb. nov.
Basionym: *Thelotrema microporum* Mont. Ann. Sci. Nat. Bot., sér. 3, 10:130 (1848).
Myriotrema microstomum (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema microstomum* Müll. Arg. Flora 74:113 (1891).
Myriotrema minutulum (Hale) Hale, comb. nov.
Basionym: *Ocellularia minutula* Hale, Smith. Contr. Bot. 38:24 (1978).
Myriotrema minutum (Hale) Hale, comb. nov.
Basionym: *Ocellularia minuta* Hale, Mycotaxon 7:379 (1978).
Myriotrema myriocarpum (Fée) Hale, comb. nov.
Basionym: *Thelotrema myriocarpum* Fée, Essai Crypt. 94 (1824).
Myriotrema myrioporoides (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema myrioporoides* Müll. Arg. in Durand & Pittier, Bull. Soc. Roy. Bot. Belg. 32:147 (1893).
Myriotrema myrioporum (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema myrioporum* Tuck. Proc. Amer. Acad. Arts Sci. 5:412 (1862).
Myriotrema myriotremoides (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema myriotremoides* Nyl. Ann. Sci. Nat. Bot., sér. 4, 11:221 (1859).
Myriotrema norsticticum (Hale) Hale, comb. nov.
Basionym: *Thelotrema norsticticum* Hale, Phytol. 26:417 (1978).
Myriotrema occultum (Eschw.) Hale, comb. nov.
Basionym: *Thelotrema occultum* Eschw. in Martius, Fl. Bras. 174 (1833).
Myriotrema pachystomum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema pachystomum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:325 (1863).
Myriotrema phaeosporum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema phaeosporum* Nyl. Ann. Sci. Nat. Bot., sér. 4, 11:242 (1859).
Myriotrema porinaceum (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema porinaceum* Müll. Arg. Nuov. G. Bot. Ital. 23:130 (1891).
Myriotrema protocetraricum (Hale) Hale, comb. nov.
Basionym: *Ocellularia protocetrarica* Hale, Smith. Contr. Bot. 38:28 (1978).

Myriotrema pulverulentum (Hale) Hale, comb. nov.
Basionym: *Ocellularia pulverulenta* Hale, Smith. Contr. Bot. 38:29 (1978).

Myriotrema pycnoporellum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema pycnoporellum* Nyl. Flora 59:562 (1876).

Myriotrema reclusum (Kremplh.) Hale, comb. nov.
Basionym: *Thelotrema reclusum* Kremplh. in Nyl. Bull. Soc. Linn. Normandie, sér. 2, 7:168 (1873).

Myriotrema rugiferum (Harm.) Hale, comb. nov.
Basionym: *Thelotrema rugiferum* Harm. Bull. Séanc. Soc. Sci. Nancy, sér. 3, 13:44 (1912).

Myriotrema santessonii (Hale) Hale, comb. nov.
Basionym: *Thelotrema santessonii* Hale, Phytol. 26:417 (1973).

Myriotrema scabridum (Hale) Hale, comb. nov.
Basionym: *Phaeotrema scabridum* Hale, Mycotaxon 7:380 (1978).

Myriotrema schizostomum (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema schizostomum* Tuck. Proc. Amer. Acad. Arts Sci. 5:411 (1862).

Myriotrema secernendum (Harm.) Hale, comb. nov.
Basionym: *Thelotrema secernendum* Harm. Bull. Séanc. Soc. Sci. Nancy, sér. 3, 13:40 (1912).

Myriotrema sphinctrinellum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema sphinctrinellum* Nyl. Acta Soc. Sci. Fenn. 7:449 (1863).

Myriotrema steyermarkii (Hale) Hale, comb. nov.
Basionym: *Thelotrema steyermarkii* Hale, Phytol. 27:496 (1974).

Myriotrema subcompunctum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema subcompunctum* Nyl. Bull. Soc. Linn. Normandie, sér. 2, 2:76 (1868).

Myriotrema subconforme (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema subconforme* Nyl. J. Linn. Soc. Bot. 20:53 (1883).

Myriotrema subwrightii (Hale) Hale, comb. nov.
Basionym: *Ocellularia subwrightii* Hale, Smith. Contr. Bot. 38:32 (1978).

Myriotrema terebrans (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema terebrans* Nyl. Bull. Soc. Linn. Normandie, sér. 2, 7:166 (1873).

Myriotrema terebratulum (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema terebratulum* Nyl. Ann. Sci. Nat. Bot., sér 5, 7:315 (1867).

Myriotrema trypaneoides (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema trypaneoides* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4; 19:335 (1863).

Myriotrema uniseptatum (Hale) Hale, comb. nov.
Basionym: *Ocellularia uniseptata* Hale, Smith. Contr. Bot. 38:33 (1978).

Myriotrema urceolare (Ach.) Hale, comb. nov.
Basionym: *Thelotrema urceolare* Ach. Kongl. Vetensk. Acad. Nya Handl. 1812:90 (1812).

Myriotrema viridialbum (Kremplh.) Hale, comb. nov.
Basionym: *Thelotrema viridialbum* Kremplh. Flora 59:221 (1876).

Myriotrema vulcani (Hale) Hale, comb. nov.
Basionym: *Phaeotrema vulcani* Hale, Smith. Contr. Bot. 38:37 (1978).

Myriotrema wightii (T. Tayl.) Hale, comb. nov.
Basionym: *Endocarpon wightii* T. Tayl. in Hook. Lond. J. Bot. 6:155 (1847).

Myriotrema wrightii (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema wrightii* Tuck. Proc. Amer. Acad. Arts Sci. 5:409 (1862).

OCELLULARIA

Ocellularia Meyer, Nebenstunden 327 (1825) (generic name conserved over *Ascidium* Fée ex anno 1824)
Type species: *Thelotrema obturatum* Ach.
Thelotrema sect. *Ascidium* (Fée) G. Salisbury
Number of species: 200

Ocellularia arecae (Vain.) Hale, comb. nov.
Basionym: *Thelotrema arecae* Vain. Hedwigia 46:174 (1907).
Ocellularia asiatica (Vain.) Hale, comb. nov.
Basionym: *Thelotrema asiaticum* Vain. Hedwigia 46:175 (1907).
Ocellularia auberiana (Mont.) Hale, comb. nov.
Basionym: *Thelotrema auberianum* Mont. in Sagra, Hist. Phys. Pol. Nat. Cuba, Bot. 163 (1842).
Ocellularia aurata (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema auratum* Tuck. Proc. Amer. Acad. Arts Sci. 5:408 (1862).
Ocellularia caledoniensis (Hale) Hale, comb. nov.
Basionym: *Phaeotrema caledoniense* Hale, Phytol. 27:494 (1974).
Ocellularia chiriquiensis (Hale) Hale, comb. nov.
Basionym: *Leptotrema chiriquiense* Hale, Smith. Contr. Bot. 38:50 (1978).
Ocellularia conformis (Fée) Hale, comb. nov.
Basionym: *Thelotrema conforme* Fée, Essai Crypt. Suppl. 89 (1837).
Ocellularia confusa (Hale) Hale, comb. nov.
Basionym: *Thelotrema confusum* Hale, Smith. Contr. Bot. 16:32 (1974).
Ocellularia crassa (Müll. Arg.) Hale, comb. nov.
Basionym: *Leptotrema crassum* Müll. Arg. Flora 65:332 (1882).
Ocellularia depressa (Mont.) Hale, comb. nov.
Basionym: *Thelotrema depressum* Mont. Ann. Sci. Nat. Bot., sér. 3, 16:73 (1851).
Ocellularia epitrypa (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema epitrypum* Nyl. Acta Soc. Sci. Fenn. 7:454 (1863).
Ocellularia erumpens (Magn.) Hale, comb. nov.
Basionym: *Thelotrema erumpens* Magn. Ark. Bot., ser. 2, 3(10):279 (1955).
Ocellularia eumorpha (Stirt.) Hale, comb. nov.
Basionym: *Thelotrema eumorphum* Stirt. Proc. Phil. Soc. Glasgow 10:158 (1877).
Ocellularia fissa (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema fissum* Nyl. Ann. Sci. Nat. Bot., sér. 4, 11:258 (1859).
Ocellularia glyphica (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema glyphicum* Nyl. Acta Soc. Sci. Fenn. 7:453 (1863).
Ocellularia grandis (Hale) Hale, comb. nov.
Basionym: *Thelotrema grande* Hale, Phytol. 26:416 (1973).

Ocellularia interponenda (Nyl.) Hale, comb. nov.
Basionym: *Ascidium interponendum* Nyl. Sert. Lich. Trop. Labuan Singapore, 20 (1891).

Ocellularia interposita (Nyl.) Hale, comb. nov.
Basionym: *Ascidium interpositum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:336 (1863).

Ocellularia leucina (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema leucinum* Müll. Arg. Rev. Mycol. 35:10 (1887).

Ocellularia leucomelaena (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema leucomelaenum* Nyl. in Triana & Planchon, Ann. Sci. Nat. Bot., sér. 4, 19:329 (1863).

Ocellularia lirelliformis (Tuck.) Hale, comb. nov.
Basionym: *Thelotrema lirelliforme* Tuck. Proc. Amer. Acad. Arts Sci. 6:270 (1864).

Ocellularia marivelensis (Vain.) Hale, comb. nov.
Basionym: *Thelotrema marivelense* Vain. Suomal. Tiedeakat. Toim., ser. A, 15:176 (1921).

Ocellularia massalongi (Mont.) Hale, comb. nov.
Basionym: *Ascidium massalongi* Mont. Ann. Sci. Nat. Bot., sér. 4, 14:174 (1860).

Ocellularia meiosperma (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema meiospermum* Nyl. Ann. Sci. Nat. Bot., sér. 4, 19:333 (1863).

Ocellularia metaphorica (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema metaphoricum* Nyl. Acta Soc. Sci. Fenn. 7:455 (1863).

Ocellularia microspora (Zahlbr.) Hale, comb. nov.
Basionym: *Leptotrema microsporum* Zahlbr. Sitzb. Akad. Wiss. Math.-nat. Abt. 1(111):392 (1902).

Ocellularia monosporoides (Nyl.) Hale, comb. nov.
Basionym: *Thelotrema monosporoides* Nyl. Lich. New Zealand, 76 (1888).

Ocellularia neodominicana Hale, nom. nov.
Basionym: *Thelotrema dominicanum* Hale, Smith. Contr. Bot. 16:33 (1974) (non *Ocellularia dominicana* Hale ex anno 1974).

Ocellularia obscura (Hale) Hale, comb. nov.
Basionym: *Phaeotrema obscurum* Hale, Smith. Contr. Bot. 16:31 (1974).

Ocellularia panamensis (Hale) Hale, comb. nov.
Basionym: *Leptotrema panamense* Hale, Smith. Contr. Bot. 38:54. (1978).

Ocellularia planaria (Hale) Hale, comb. nov.
Basionym: *Thelotrema planarium* Hale, Mycotaxon 7:382 (1978).

Ocellularia praestans (Müll. Arg.) Hale, comb. nov.
Basionym: *Thelotrema praestans* Müll. Arg. J. Linn. Soc. Lond. 30:453 (1895).

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Basionym: *Phaeotrema psoromicum* Hale, Mycotaxon 7:380 (1978).

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Basionym: *Phaeotrema sticticum* Hale, Mycotaxon 3:176 (1975).

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Basionym: *Thelotrema stramineum* Vain. Suomal. Tiedeakat. Toim., ser. A, 5:181 (1921).

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 Basionym: *Thelotrema subpraestans* Hale, Phytol. 27:497 (1974).
Ocellularia subsimilis (Hale) Hale, comb. nov.
 Basionym: *Thelotrema subsimile* Hale, Phytol. 27:497 (1974).
Ocellularia tenuis (Hale) Hale, comb. nov.
 Basionym: *Thelotrema tenue* Hale, Smith. Contr. Bot. 16:38 (1974).
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 Basionym: *Phaeotrema virens* Müll. Arg. Flora 70:398 (1887).

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SONORAN DESERT MYXOMYCETES[1]

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SUMMARY

Thirty-three species of Myxomycetes are reported from the Sonoran Desert of Arizona; 46 species are now known from this region. This unexpected variety includes some seldom collected species such as *Licea fimicola*, *Fuligo megaspora*, *Physarum straminipes*, *Didymium* sp. (in press), and *D. karstensii*, and three undescribed species. Field observations and cultural studies indicate that sclerotial formation and production of small plasmodia are important in the life cycle of some of these organisms which are common on dead plant and dung substrates. Spore-to-spore agar culture of *Badhamia affinis*, *Physarum notabile*, and *P. straminipes* is reported for the first time.

Myxomycetes are known primarily as inhabitants of temperate hardwood and coniferous forests and boreal forests (Martin and Alexopoulos, 1969). Some are known from rain forests and other tropical vegetation types (Alexopoulos, 1970; Farr, 1974; Reynolds and Alexopoulos, 1971; Alexopoulos and Saenz, 1975; Braun and Keller, 1976; Keller and Braun, 1977). But few field collected specimens have been reported from desert regions (Table 1).

Ramon (1968) reported three species of Myxomycetes from the Saharan-Sindian phytogeographical territory, and she attributed the small number of total species in Israel to the arid character of the country. In a more comprehensive report of North African Myxomycetes, Faurel et al. (1965) reported species for Morocco, Algeria, and Tunisia, including twelve desert species from moist chamber-cultured dung of Saharan animals (Table 1).

The small number of Myxomycetes (24) previously known from the Sonoran Desert (almost all from moist chamber cultures) is probably due to the fact that almost no collecting of slime molds has been done there (Evenson, 1961) (Table 1). Several fungal groups are now known to be well represented in the Sonoran Desert. These include rusts

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 3096.

Table 1. Myxomycete species previously reported from desert habitats.

Species	Locality	References
Comatricha laxa Rost.	Arizona	Evenson (1961)
C. lurida A. Lister	*Arizona	Evenson (1961)
C. nigra (Pers.) Schroet.	*Algeria	Faurel et al. (1965)
C. pulchella (C. Bab.) Rost.	*Algeria *Arizona	Faurel et al. (1965) Evenson (1961)
Stemonitis flavogenita Jahn	*Arizona	Evenson (1961)
Echinostelium colliculosum Whitney et Keller	*Arizona	Whitney and Keller (1980)
Licea fimicola Dearness et Bisby	*Arizona	Evenson (1961)
L. pseudoconica Brooks et Keller	*Arizona	Keller and Brooks (1977)
Perichaena chrysosperma (Curry) A. Lister	*Arizona	Evenson (1961)
P. corticalis (Batsch) Rost.	*Arizona *Algeria	Evenson (1961) Faurel et al. (1965)
P. depressa Libert	*Arizona	Evenson (1961)
P. vermicularis (Schw.) Rost.	*Arizona	Evenson (1961)
Arcyria cinerea (Bull.) Pers.	*Arizona *Algeria	Evenson (1961)
A. insignis Kalchbr. et Cooke	*Arizona	Evenson (1961)
Badhamia macrocarpa (Ces.) Rost.	Arizona Israel	Evenson (1961) Ramon (1968)
B. panicea (Fries) Rost.	*Arizona	Evenson (1961)
Fuligo cinerea (Schw.) Morgan	Mexico	Braun and Keller (1976)
F. megaspora Sturgis	New Mexico	Martin and Alexopoulos (1969)

Table 1. Myxomycete species previously reported from desert habitats - (continued).

Species	Locality	References
Craterium leucocephalum (Pers.) Ditmar	*Algeria	Faurel et al. (1965)
Physarum compressum Alb. et Schw.	*Algeria *Arizona	Faurel et al. (1965) Evenson (1961)
P. didermoides (Pers.) Rost.	*Algeria	Faurel et al. (1965)
P. leucopus Link	*Algeria	Faurel et al. (1965)
P. mutabile (Rost.) G. Lister	*Arizona	Evenson (1961)
P. notabile Macbr.	Arizona	Evenson (1961)
P. nucleatum Rex	*Algeria	Faurel et al. (1965)
P. pusillum (Berk. et Curt.) G. Lister	*Arizona Israel	Evenson (1961) Ramon (1968)
Physarum sp.	*Arizona	Ranzoni (1968)
Colloderma oculatum (Lippert) G. Lister	*Algeria	Faurel et al. (1965)
Diderma simplex (Schroet.) G. Lister	*Algeria	Faurel et al. (1965)
Didymium anellus Morgan	*Arizona	Evenson (1961)
D. difforme (Pers.) S. F. Gray	Israel	Ramon (1968)
D. dubium Rost.	*Arizona	Evenson (1961)
D. nigripes (Link) Fries	*Arizona	Raper and Alexopoulos (1973)
D. vaccinium (Dur. et Mont.) Buchet	*Arizona	Evenson (1961)
unidentified plasmodium	*Arizona	Ranzoni (1968)

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*Known only from moist chamber culture at this locality.

(Cummins, 1979), wood-rotting fungi (Lindsey and Gilbertson, 1975; Gilbertson et al., 1976; Nakasone and Gilbertson, 1978), and downy mildews (Solheim and Gilbertson, 1970).

Recent field collections and moist chamber cultures of substrates have yielded 33 myxomycete species for a total of 46 species from the Sonoran Desert of Arizona including *Licea fimicola* Dearness et Bisby, *Fuligo megaspora* Sturgis, *Physarum straminipes* Lister, *Didymium* sp. (Blackwell and Gilbertson, 1980), and *D. karstensii* Nann.-Brem., and three undescribed species. *Badhamia gracilis* (Macbr.) Macbr., *Physarum leucophaeum* Fries, *P. straminipes* Lister, and *Comatricha laxa* Rost. are common. This unexpected variety and abundance is of great interest in a group known primarily from more mesic habitats.

Sonoran Desert localities commonly receive four to six inches of precipitation during the two month period of July and August. A winter rainy season during December and January (Smith, 1956) also provides conditions favorable for fruiting of Myxomycetes. A variety of substrates which supports fungal growth is provided by the large number of species of vascular plants in the Sonoran Desert (Shreve and Wiggins, 1964). All field collections and plant moist chamber developments reported here are from fallen dead plants or dead parts of living plants in contact with the ground. The most common substrates for field collections are cacti which have a thickened outer tissue covering the cortex and vascular tissue. Our field observations show that these plants retain some moisture up to a month after the last precipitation, and the temperature beneath them is sometimes 20°C cooler than that of the bare soil surface in summer. Only occasional specimens are collected in the field on hardwoods. In addition dung of herbivorous animals is abundant and is another important substrate for Myxomycetes. Of approximately 80 species of Myxomycetes known to occur on dung (Eliasson and Lundqvist, 1979), twenty species (Table 2) are reported from moist chamber cultures of dung of desert animals.

Two or more species of slime molds fruiting in a small area on the same substrate was common. The presence of inconspicuous sporangia of additional species often was not discovered until the collections were examined in the laboratory under a dissecting microscope. The letter after the collection number denotes specimens from the same collection. We believe that this close sympatry indicates a limited number of favorable microhabitats for myxomycete growth and fruiting.

Moist chamber culture observations and limited agar culture studies indicate that sclerotia play an important part in the life of these desert-inhabiting organisms. Sclerotia are also frequently found in field collections either associated with sporangia or as the only stage present. The ability to sclerotize quickly and for sclerotia to germinate and produce plasmodia and fruiting bodies quickly would be an important attribute for survival under desert conditions.

Alexopoulos (1964) discussed the rapid sporulation of some Myxomycetes in moist chamber culture. Sporangia produced in fewer than five days usually belonged to species with proto- or aphanoplasmodia. We have observed fruiting of *Echinostelium minutum* deBary within 7 to 8 days of wetting moist chamber material. In addition, *Didymium* sp. (Blackwell and Gilbertson, 1980) and an undescribed species of

Table 2. Myxomycete species known from herbivorous animal dung collected in deserts.

Species	References
Comatricha nigra (Pers.) Schroet.	Faurel et al. (1965)
C. pulchella (C. Bab.) Rost.	Faurel et al. (1965)
Licea fimicola Dearn. et Bisby	Angel and Wicklow (1975); cited here
Perichaena corticalis (Batsch) Rost.	Faurel et al. (1965)
Arcyria cinerea (Bull.) Pers.	Faurel et al. (1965)
Echinostelium minutum deBary	cited here
Badhamia gracilis (Macbr.) Macbr.	cited here
Badhamia sp.	cited here
Fuligo cinerea (Schw.) Morgan	cited here
F. septica (L.) Wiggers	cited here
Physarum compressum Alb. et Schw.	Faurel et al. (1965)
P. didermoides (Pers.) Rost.	Faurel et al. (1965)
P. leucopus Link	Faurel et al. (1965)
P. nucleatum Rex	Faurel et al. (1965)
P. pusillum (Bert. et Curt.) G. Lister	Faurel et al. (1965); cited here
Craterium leucocephalum (Pers.) Ditmar	Faurel et al. (1965)
Diderma simplex (Schroet.) G. Lister	Faurel et al. (1965)
Didymium anellus Morgan	cited here
D. iridis (Ditmar) Fries	cited here
Colloderma oculatum (Lippert) G. Lister	Faurel et al. (1965)

Didymium fruited within five days. In agar culture these two species have extremely small phaneroplasmodia which produce single sporangia (Blackwell and Gilbertson, 1980) and form sclerotia of discrete macrocysts similar to those reported by Alexopoulos (1964) for species of *Comatrichia, Stemonitis, Arcyria,* and *Perichaena.* An even more intriguing observation was the appearance of one to four sporangia of *Badhamia gracilis* within one to three days after wetting and numerous sporangia within six days in *B. gracilis* and *Physarum straminipes.* The large phaneroplasmodia of these two species were often observed the day after wetting, and almost certainly formed from sclerotia although none was observed on the substrates.

The records on which this paper is based were taken from specimens in the University of Arizona Herbarium and specimens collected in the field by the authors during the spring, summer, and winter of 1979. Additional specimens which are indicated were obtained from moist chamber cultures of various desert substrates (Gilbert and Martin, 1933). The myxomycete classification of Martin and Alexopoulos (1969) is followed. Plant substrate nomenclature follows Kearny and Peebles (1966). All specimens are deposited in the University of Arizona Herbarium. Collecting localities in Arizona are listed below.

> Tucson environs, Pima Co., 2400 ft; Saguaro National Monument, West Unit (SNMW), Tucson Mtn. foothills, Pima Co., 2600 ft; Sil Nakya Hills (SNH), Papago Indian Reservation, Pima Co., 2400 ft; Molino Basin, Santa Catalina Mts., Pima County, 4500 ft; Santa Rosa Valley, Papago Indian Reservation, Pinal Co., 2000 ft; Organ Pipe National Monument, Quitoboquito Spring, Pima Co., 1500 ft; Saguaro National Monument, East Unit (SNME), Rincon Mtn. foothills, Pima Co., 3100 ft; Redington Pass Rd. (RPR), Rincon Mtn. foothills, Pima Co., 5300 ft; Orange Grove Rd. (OGR), Santa Catalina Mtn. foothills, Pima Co., 2700 ft; Camino Padre Isidoro (CPI), Santa Catalina Mtn. foothills, Pima Co., 2800 ft; Santa Rita Experimental Range (SRER), Santa Rita Mtn. foothills, Pima Co., 3500 ft; Mt. Lemmon Hwy., Old Federal Prison Camp (Head of Soldier Canyon), Pima Co., 5000 ft; Superior, Dripping Springs Mtns., Pinal Co., 2600 ft.

COMATRICHA LAXA Rost. - OGR, on corrugated cardboard, 25 Aug. 1979, 79-054; SNME, on *Carnegiea gigantea* (Engelm.) Britt. et Rose (saguaro), 28 Aug. 1979, 79-068; SNME on *Cercidium microphyllum* (Torr.) Rose et Johnst. (yellow palo verde), 28 Aug. 1979, 79-067B; CPI on *Prosopis juliflora* (SW.) DC. (mesquite), 26 Aug. 1979, 79-056B; ORG, on *Opuntia fulgida* Engelm. (jumping cholla), 25 Aug. 1979, 79-058C; SRER, on jumping cholla, 24 Aug. 1979, 79-045B.

The genus *Comatricha* is well represented in alpine habitats of Arizona (Evenson, 1961; Gilbertson and Blackwell, unpublished). Although *C. laxa* was the only species collected by us in the desert it was common in several localities. Collection 79-054 occupied a 2 x 4 ft area on three layers of a discarded corrugated cardboard box which had been rain-soaked three weeks before collection.

LICEA FIMICOLA Dearness et Bisby - Tucson, on goat (?) dung, U. of Arizona Mycology class, moist chamber, Feb. 1977.

LICEA PARASITICA (Zukal) Martin - SNMW nature trail, on *Olneya tesota* Gray (ironwood), 21 Aug. 1979, 79-041B; OGR, on jumping cholla, 25 Aug.

BADHAMIA GRACILIS (Macbr.) Macbr. - Tanque Verde Rd., on deer dung, moist chamber, substrate collected May 1979, wet 14 May 1979, fruited 29 May 1979, 79-012; SNMW, on saguaro, moist chamber, substrate collected July 1973, wet 14 May 1979, fruited 22 May 1979, 79-017A; SNH, on *Lemaireocereus thurberi* (Engelm) Britt. et Rose (organ pipe cactus), 8 June 1979, RLG 12069A; SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 27 June 1979, 79-019B; SNH, on saguaro, 8 June 1979, RLG 12072C; SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 24 June - 26 June 1979, 79-021; SNH, on jack rabbit dung, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 23 June - 30 June 1979, 79-027; *CPI, on unidentified herbivorous dung, moist chamber, substrate collected Oct. 1978, wet 20 Nov. 1978, fruited 8 Dec. 1978, 79-031C; SNMW, Signal Hill, on saguaro, 22 Aug. 1979, 79-033B, 79-035, 79-037, 79-038, 79-039; CPI, on *Opuntia phaeacantha* Engelm. (Engelmann prickly pear), 26 Aug. 1979, 79-049, 79-051; OGR, on jumping cholla, 25 Aug. 1974, 79-052B; OGR, on Engelmann prickly pear, 25 Aug. 1979, 79-053; OGR, on *Ferocactus wislizenii* (Engelm.) Britt et Rose (barrel cactus) 25 Aug. 1979, 79-055; OGR, on *Fouquieria splendens* Engelm. (ocotillo), 25 Aug. 1979, 79-057; OGR, on jumping cholla, 25 Aug. 1979, 79-059; OGR, on Engelmann prickly pear, 25 Aug. 1979, 79-060, 79-062; SNME, nature trail, on saguaro, 28 Aug. 1979, 79-065, 79-066; Organ Pipe National Monument, Quitoboquito Spring, on *Populus fremontii* S. Wats. (Fremont cottonwood), 31 Mar. 1979, RLG 11947; SRV, on saguaro, 11 Nov. 1971, Elmer R. Canfield No. 71-364; Old Federal Prison Camp, on Parry agave, 20 Nov. 1979, RLG 12277; RLG 12279; RLG 12282B; RLG 12281; OGR, on Engelmann prickly pear, 11 Nov. 1979, RLG 12251; RLG 12252; RLG 12253; CPI, on *Aloe saponaria* Haw. (aloe) 11 Nov. 1979, RLG 12244; CPI, on *Agave americana*L. (American agave) 11 Nov. 1979, RLG 12245; SNMW, on saguaro, 14 Nov. 1979, RLG 12270; SNMW, on Engelmann prickly pear, 14 Nov. 1979, RLG 12273; Molino Basin, on Parry agave, 13 Nov. 1979, RLG 12261; SNH, on saguaro, 7 Nov. 1979, RLG 12238; SNH, on organ pipe cactus, 7 Nov. 1979, RLG 12235; RLG 12239.

This species was collected in all localities where dead cacti were examined and was one of the few species found in large fruitings. Spore markings (Scheetz and Alexopoulos, 1971) were consistent in all collections and in agar-cultured material, and spore color was generally dark but somewhat variable.

BADHAMIA MACROCARPA (Ces.) Rost. - SNMW, nature trail, on ironwood, 21 Aug. 1979, 79-041A.

BADHAMIA SP. - *RPR, on old cow dung, moist chamber, substrate collected May 1979, wet 14 May 1979, fruited 24 May 1979, 79-014B.

In culture this species consistently had distinctly oval spores with spines at one end and side with the other end and side smooth. Except for the spore ornamentation this specimen is similar to *B. ovispora* Racib. and *B. apiculospora* (Härkönen) U. Eliass. et Lundq.

BADHAMIA PANICEA (Fries) Rost. - SRER, on jumping cholla, 24 Aug. 1979, 79-046; SNH, Papago Indian Reservation, on saguaro, 8 June 1979, RLG 12072A.

PHYSARUM AURISCALPIUM Cooke - Santa Rita Exp. Range, on jumping cholla, 24 Aug. 1979, 79-045D.

PHYSARUM COMPRESSUM Alb. et Schw. - SNMW, Signal Hill, on saguaro, 22 Aug. 1979, 79-033A, 79-034, 79-036.

PHYSARUM LATERITIUM (Berk. et Rav.) Morgan - SNH, on organ pipe cactus, moist chamber, substrate collected 8 June, 1979, wet 2 June 1979, (red sclerotium), fruited 23 July 1979, 79-026A.

This specimen was collected as a yellow plasmodium which formed a red sclerotium before being placed in moist chamber culture. The plasmodium did not fruit until it was placed in direct light from a window.

PHYSARUM LEUCOPHAEUM Fries - SNMW, nature trail, on saguaro, 21 Aug. 1979, 79-042A; SNMW, Loop Rd., on jumping cholla, 21 Aug. 1979, 79-044; SRER, on jumping cholla, 24 Aug. 1979, 79-045C; OGR, on jumping cholla, 25 Aug. 1979, 79-052, 79-058B; OGR, on Engelmann prickly pear, 25 Aug. 1979, 79-061; SNME, nature trail, on yellow palo verde, 28 Aug. 1979, 79-063B; 79-067A.

PHYSARUM LUTEOLUM Peck - Molino Basin, on Parry agave, 13 Nov. 1979, RLG 12274.

PHYSARUM NOTABILE Macbr. - SNMW, nature trail, on saguaro, 21 Aug. 1979, 79-042B.

PHYSARUM PUSILLUM (Berk. et Curt.) G. Lister - *CPI, on unidentified herbivorous dung, moist chamber, substrate collected Oct. 1978, wet Nov. 1978, fruited 2 Dec. 1978, 79-031B.

PHYSARUM STRAMINIPES Lister - SNMW, on saguaro, moist chamber, substrate collected July 1973, wet 14 May 1979, 79-017C; SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 27 June, 1979, 79-019C; SNH, on organ pipe cactus, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 26 June 1979, 79-023; SNH, on saguaro, 8 June 1979, RLG *12069B, 12071, 12072B; SNH, on saguaro, 7 Nov. 1979, RLG 12234; RLG 12257.

This is the third report of *P. straminipes* from the Western Hemisphere. Spore and sporangial morphology agreed with the description of Martin and Alexopoulos (1969). Sporangial stalks were short and stout in moist chamber developments and lacking in field collected specimens. Spores were distinctly ornamented with pale lines due to absence of spines. These pale areas were usually the site of wrinkles forming an overlying reticulum (Sheetz and Alexopoulos, 1976).

PHYSARUM VERNUM Somm. ex Fries - *CPI, cultivated sedge debris, 26 Aug. 1979, 79-050; CPI, on American agave, 11 Nov. 1979, RLG 12244; SNME, nature trail, on yellow palo verde, 28 Aug. 1979, 79-063A; Old Federal Prison Camp, on dead leaves of *Agave schottii*, 10 Sept. 1979, RLG 12151.

DIDYMIUM ANELLUS Morgan - *CPI, unidentified herbivorous dung, moist chamber, substrate collected Oct. 1978, wet 20 Nov. 1978, fruited 2 Dec. 1978, 79-031E.

This specimen grew easily from spore to spore in agar culture.

DIDYMIUM DUBIUM Rost. - SNME, nature trail, on yellow palo verde, 28 Aug. 1979, 79-064.

1979, 79-058A.

LICEA PEDICELLATA (H. C. Gilbert) H. C. Gilbert - SRER, on jumping cholla, 24 Aug. 1979, 79-045E.

PERICHAENA CORTICALIS (Batsch) Rost. - SNMW nature trail, on saguaro, 21 Aug. 1979, 79-040; SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited ?, 79-019E; Dripping Springs Mtns., 10 mi S. Superior, on saguaro, RLG 10549, 4 Nov. 1971.

PERICHAENA DEPRESSA Libert - Molino Basin, on *Agave parryi* Engelm. (Parry agave) 13 Nov. 1979, RLG 12262.

PERICHAENA VERMICULARIS (Schw.) Rost. - SNH, on *Opuntia* sp. (cholla), moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 2 July 1979, 79-018B; SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 2 July 1979, 79-019D. Old Federal Prison Camp, on Parry agave, 20 Nov. 1979, RLG 12278; RLG 12280; RLG 12282A.

ECHINOSTELIUM MINUTUM deBary - Tucson, on unidentified dung, moist chamber, substrate collected Oct. 1978, wet 14 May 1979, fruited 29 May 1979, 79-010; RPR, on cow dung, moist chamber, substrate collected May 1979, wet 14 May 1979, fruited 22 May 1979, 79-014A; SNH, on cholla, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 28 June 1979, 79-018A.

FULIGO CINEREA (Schw.) Morgan - *CPI, Tucson, on unidentified herbivorous dung, moist chamber, substrate collected Oct. 1978, wet 20 Nov. 1978, fruited 2 Dec. 1978, 79-031D.

In agar culture this isolate of *F. cinerea* grew easily. Some plasmodial fragments always sclerotized when the main part of the plasmodium fruited.

FULIGO MEGASPORA Sturgis - Tucson Rose Garden, on soil, 26 June 1950, R. B. Streets.

This specimen is typical of the description given by Martin and Alexopoulos (1969), except that spore size is smaller (13-15 µm).

FULIGO SEPTICA (L.) Wiggers - SNMW nature trail, on soil, 21 Aug. 1979, 79-043; Circle O Worm Ranch (brought into plant clinic), on horse dung, 24 June 1976; SNH, on soil, 7 Nov. 1979, RLG 12241; on leaf mold in flower bed, Sept. 1979, RLG 12248.

A single well-matured aethalium (79-043) was collected on bare unshaded desert soil. Soil temperature was approximately 62 C (130 F).

BADHAMIA AFFINIS Rost. - *CPI, Tucson, on mesquite, 26 Aug. 1979, 79-056A; SNH, on saguaro, 8 June 1979, RLG 12069C; SNMW, on saguaro, 14 Nov. 1979, RLG 12271.

One specimen was grown from spore-to-spore on half strength corn meal agar, and sporangial morphology was consistent with field collected material.

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*Denotes spore-to-spore culture on half strength corn meal agar (Gray and Alexopoulos, 1968).

DIDYMIUM SP. (Blackwell and Gilbertson, 1980) - *SNMW, on saguaro, moist chamber, substrate collected July 1973, wet 14 May 1979, fruited 22 May 1979, 79-017B (Type); SNH, on saguaro, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 26 June 1979, 79-019A.

The minute sporangia of this species fruited abundantly on the moist chamber-cultured saguaro from Saguaro National Monument. Only four sporangia were produced from Sil Nakya Hills, but they were similar in all respects to the SNM collection. In half strength corn meal agar culture plasmodia formed numerous sclerotia (Blackwell and Gilbertson, 1980).

DIDYMIUM IRIDIS (Ditmar) Fries - *CPI, unidentified herbivorous dung, moist chamber, substrate collected Oct. 1978, wet 20 Nov. 1978, fruited 6 Dec. 1978, 79-031A.

Mass spore, single-spore, and sclerotial cultures on agar produced numerous phaneroplasmodia which remained small and produced up to five or six sporangia upon fruiting.

DIDYMIUM KARSTENSII Nann.-Brem. -*SNMW, nature trail, on ironwood, 21 Aug. 1979, 79-041C.

Didymium karstensii is similar to *D. squamulosum* except for spore morphology. Spores have a rough overlying reticulum like that of *Badhamia gracilis* and *Physarum straminipes*. The presumptive phaneroplasmodium of this species developed from field collected spores sown on half strength corn meal agar was colorless to slightly creamy. Sclerotia formed abundantly, but sporulation was aberrant and prevented positive identification.

DIDYMIUM SP. - *SNH, on organ pipe cactus, moist chamber, substrate collected 8 June 1979, wet 21 June 1979, fruited 26 June 1979, 79-026B.

This undescribed species produced small, pulvinate sporangia. Distinctive capillitial ornamentation of bell-shaped enlargements in moist chamber developments was not present in agar-cultured sporangia. Minute phaneroplasmodia similar to those found in *D. eremophilum* produced a single sporangium. In culture the plasmodia sclerotized readily.

DIDERMA EFFUSUM Link - SRER, on jumping cholla, 24 Aug. 1979, 79-048.

DIDERMA SP. - SRER, on jumping cholla, 24 Aug. 1979, 79-045A.

This specimen consists of pale pink effused plasmodiocarps with highly branched, dark, thick capillitium, and spores paler on one side. The spores germinated, but did not produce plasmodia in agar culture.

ACKNOWLEDGMENTS

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MYCOTAXON

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DIDYMIUM ATRICHUM, A NEW MYXOMYCETE FROM SOUTH-CENTRAL TEXAS

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SUMMARY

Didymium atrichum M. R. Henney and Alexopoulos is described from south-central Texas. Because of the presence of crystalline lime on its peridium, the organism is placed in the genus Didymium despite its lack of capillitium. The sporangia are produced either singly or in heaped clusters resembling pseudoaethalia. The spores, under the oil immersion objective of the light microscope, appear to be minutely verrucose or faintly reticulate, but the scanning electron microscope reveals a conspicuous, if sometimes broken, reticulation. The often clustered sessile sporangia, the complete absence of capillitium and the reticulate spores, all characters which have proved to be stable on various natural and artificial substrata under three conditions of temperature and after numerous subcultures in the last 16 years, make Didymium atrichum difficult to confuse with any previously known myxomycete. The organism completes its life cycle from spore to spore in mass-spore culture within seven days under favorable conditions, and in monosporous culture in about 14 days. Light is not required

by the milky white phaneroplasmodium to sporulate.

INTRODUCTION

On December 29 and 30, 1962, one of us (MRH) collected various materials in south-central Texas for moist chamber cultures, hoping to develop myxomycete fructifications for a continuing project which aims to assemble a list of Myxomycetes occurring in Texas (Alexopoulos, 1965; Alexopoulos and Henney, 1971). This material was placed in moist chambers a few days later according to the method of Gilbert and Martin (1933). Several minute, sessile myxomycete sporangia (Figure 10)[1] devoid of capillitium, but with fully matured spores, which developed on a leaf that had fallen from a Bauhinia sp. tree, could not be placed in any known species, but appeared to belong to the genus Didymium because of the crystalline lime on their peridia (Figures 11-14). Spores were well developed and their markings were quite different from those of any known species of Didymium. Under the phase contrast oil immersion objective they appear to be faintly reticulate in some specimens and punctate or spiny in others. The scanning electron microscope, however, revealed a very conspicuous reticulation (Figure 19) in all spores examined. No columella was present in any of the sporangia examined, except for a small calcareous dome in some sporangia, which might be interpreted as a rudimentary columella. Energy dispersive x-ray spectrometry[2] has demonstrated (Figure 20) the presence of phosphorus in the sporangia. Schoknecht (1975) reported traces of phosphorus in Didymium trachysporum G. Lister.

MATERIALS, METHODS, AND RESULTS

Isolation. Spores from several sporangia were suspended in about 3 ml of sterile distilled water in a small screw cap tube, which was shaken vigorously for a few seconds to disperse the spores. Monosporous cultures were prepared by spreading a few loopfuls of the spore suspension and of a suspension of Enterobacter aerogenes cells over the surface of three Petri dishes containing lactose-yeast (LY) 3% agar and allowing them to dry. Well-separated spores were cut out under a dissecting microscope at 90X magnification and transplanted to a plate containing five or six glass rings embedded in LY agar, one spore to a ring. Each ring was then checked under the low power of a compound microscope to insure that it contained but a single spore.

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[1] All material for SEM was prepared according to standard procedures (Scheetz & Alexopoulos, 1976).

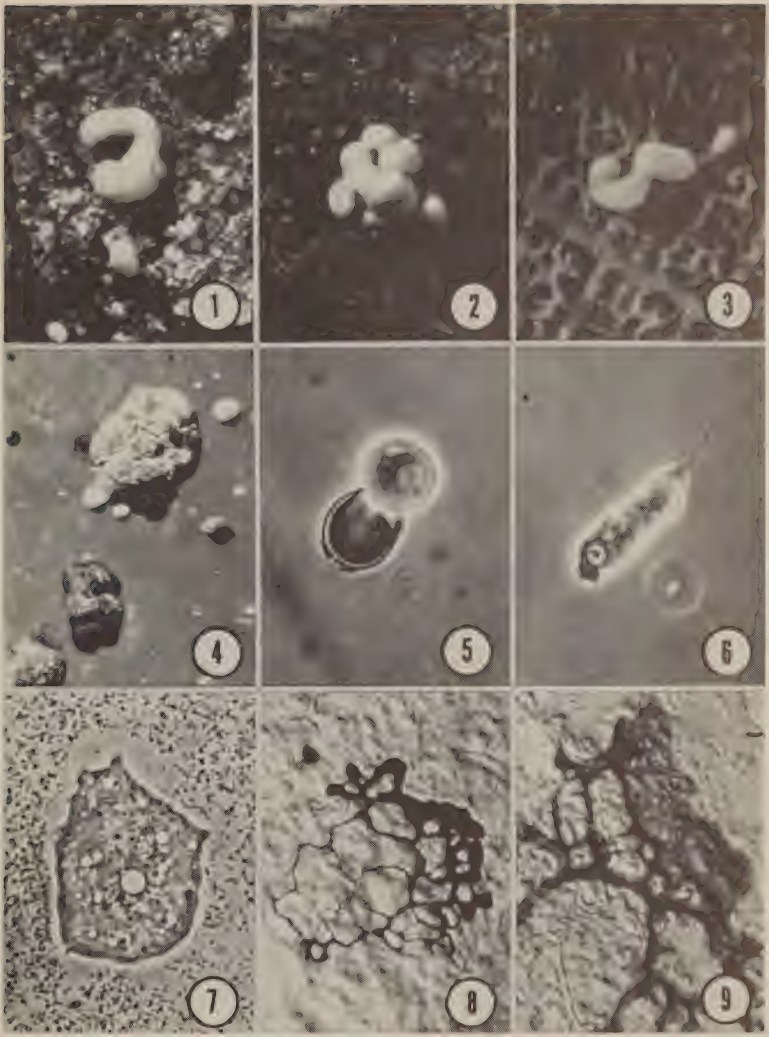
[2] Procedure described in Nelson, Scheetz, and Alexopoulos, (1977).

As it turned out, the organism completed its life cycle in monosporous culture, and mass spore transfers were routinely made thereafter to perpetuate the organism in culture. Smart (1937) indicated that germination of single myxomycete spores is more difficult than germination in mass spore sowings. This presented no serious problem with our organism, as 54.8% of the isolated spores germinated in our experiments.

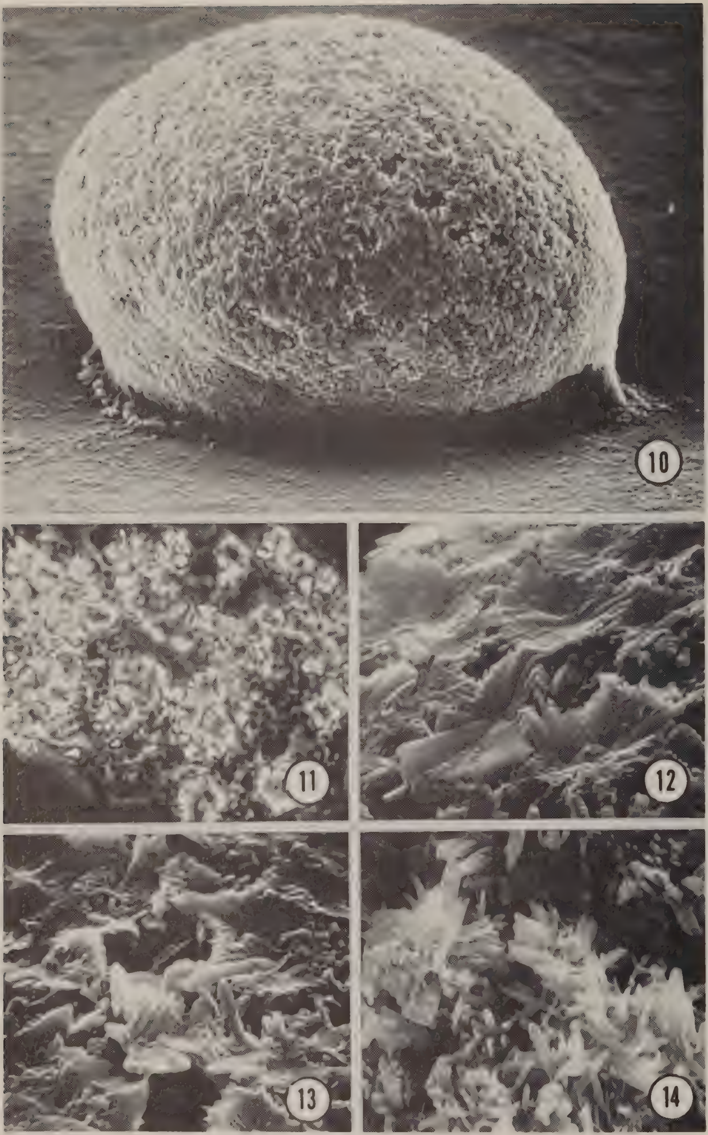
Spore germination. Spore germination was observed many times in hanging drops prepared as follows: Melted, hot LY agar was poured onto a large (45 X 50 mm) cover slip and the excess agar was drained off leaving a thin film on the cover glass. After a few seconds when the agar was dry, two drops of sterile water were placed on the agar in the middle of the cover slip and inoculated with spores from a 14-day old culture that had sporulated freely. This preparation was inverted over a small, plastic Petri dish half filled with sterile water.

Spore germination could be observed in the hanging drop through the cover slip and the thin layer of agar, under the low and high powers of the microscope and often under the oil immersion objective. Spores were examined every hour from the time of inoculation until the germination process had been completed.

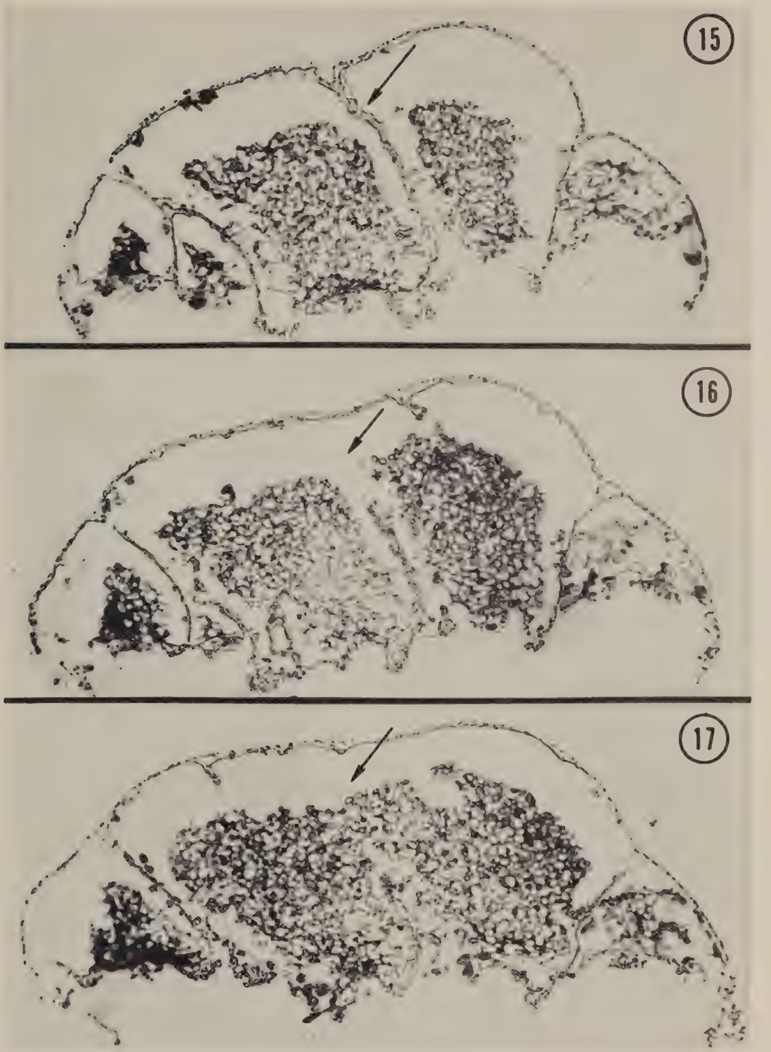
Spores germinate by the cracking method as described by Gilbert (1928) for Fuligo septica (L) Wiggers and as is characteristic of the Physarales in general. The first indication of germination is a slight crack in the spore wall. This is soon followed by a flow of protoplasm through the V-shaped opening. At first myxamoebal (Figure 5), the protoplast becomes very active, produces flagella, and swims away as a swarm cell (Figure 6). Two hours after inoculation many swarm cells could be seen in the hanging drop. Maximum germination occurs in two to five hours. Never was more than one protoplast seen emerging from a spore.



Figures 1-9. Didymium atrichum. 1. Sporangia on bark. SEM X 56. 2. Clustered sporangia on bark. SEM X 32. 3. Sporangia on leaf. SEM X 32. 4. Clustered sporangia on agar. SEM X 27. 5. Germinating spore. Phase contrast X 9,950. 6. Swarm cell. Phase contrast X 1,000. 7. Young plasmodium. Phase contrast. X 90. 8. Plasmodium at a later stage. X 16. 9. Almost full grown plasmodium X 16.



Figures 10-14. Didymium atrichum. 10. Mature sporangium. Note hypothallus. SEM X 555. 11. Aggregate of lime crystals. Phase contrast X 1,400. 12. Peridium. SEM X 10,250. 13. Peridium. SEM X 4,700. 14. Peridium. SEM X 2,500.



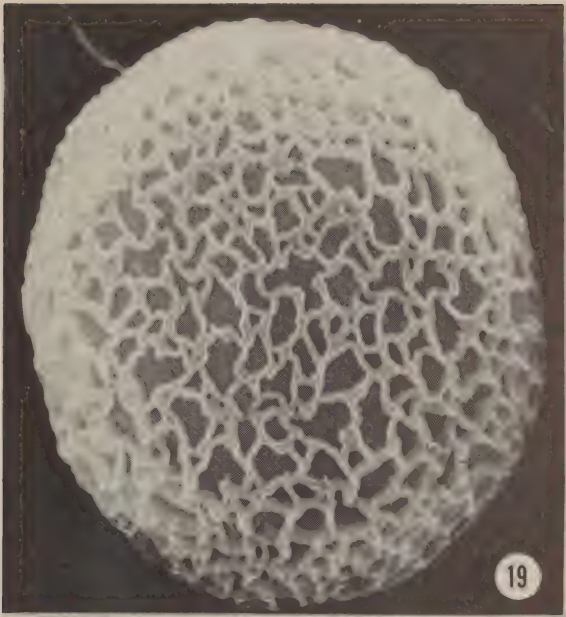
Figures 15-17. Didymium atrichum. Sequential sections through a cluster of sporangia. Note incomplete partitions at arrows. X 121.

Syngamy and Plasmodial Formation. Fusion of swarm cells at their posterior ends was seen on a few occasions, but karyogamy was not observed. It is, therefore, impossible to state whether this strain of the organism is homothallic or apogamic. Because only a single protoplast was seen ever to issue from a spore, however, it appears probable that heterothallism is not involved.

Plasmodia apparently develop through the enlargement of a single protoplast -- myxamoeba or possibly zygote. These never grow very large, but appear to split after reaching a certain size. Although remaining very small, the plasmodia develop veins and terminal fans characteristic of phaneroplasmodia (Figures 7-9). Their protoplasm is highly vacuolate and very granular, characters also typical for this type of plasmodium. At first colorless, the plasmodia become milky white as they grow.

Sporulation. At 25 C, on LY agar, this organism completes its life cycle from spore to spore in seven days from mass spore sowings, but in 14 days in monosporous culture. Each plasmodium becomes concentrated and, depending on its size at the time of sporulation, forms one to several single or closely grouped fruiting bodies (Figure 4). In the latter case, the sporangia form mounds and appear to be actually fused as is evident in the three sections through one such mass in which incomplete walls separate individual sporangia (Figures 15-17). Whether such masses are simple aggregations of sporangia, pseudoaethalia, or aethalia, is a matter of interpretation. The fact remains that both single and massed sporangia are formed under all conditions studied and on all substrata. The proportion of single and massed sporangia varies in different cultures, but at no time could it be correlated with either type of substratum or temperature. We believe that the size a plasmodium attains by the time it sporulates is a factor that influences the type of fructification produced, the larger plasmodia tending, perhaps, to produce masses of fruiting bodies.

Effect of Temperature and Substrate on Plasmodial Formation and Sporulation. Plasmodial formation and sporulation were studied under three conditions of temperature on five agar media in triplicate. A single spore was planted, allowed to germinate and complete the life cycle on agar, forming a multitude of tiny sporangia. The spores of 150 of these sporangia were placed in 50 ml of sterile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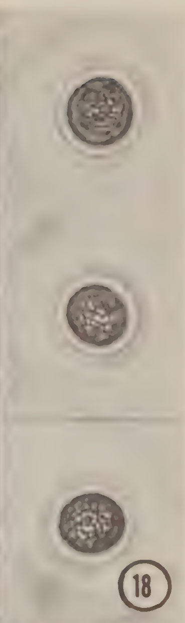
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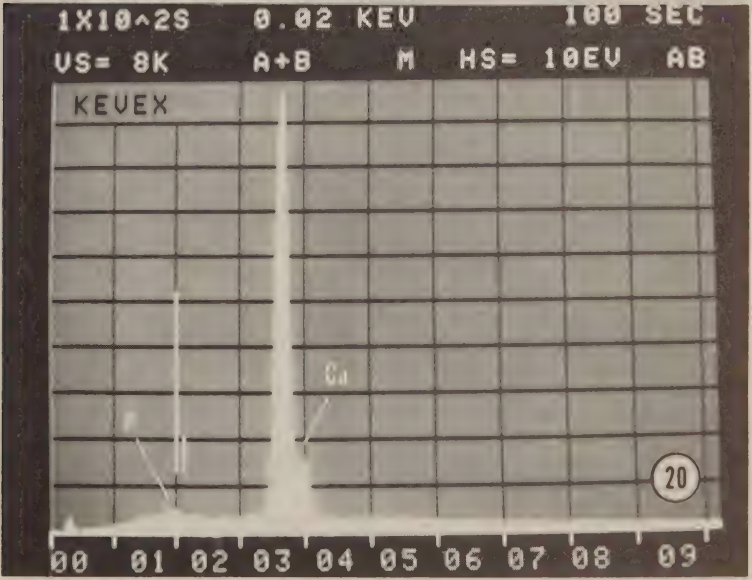

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Figures 18-20. Didymium atrichum. 18. Spores. Phase contrast X 1,050. 19. Spore. SEM X 9,700. 20. Energy dispersive x-ray spectrum of the peridium.

distilled water. The number of spores was determined to be 250/0.1 ml, by the use of a bright-line hemocytometer. Twenty determinations were made and the average computed. Five different media were used and three temperatures. One-tenth ml of a spore suspension was plated onto 100 X 20 mm Petri dishes containing the following media: lactose-yeast, corn meal, half-strength corn meal, Bristol's, and plain agar. Enterobacter aerogenes was used as the associated organism. All experiments were performed in triplicate.

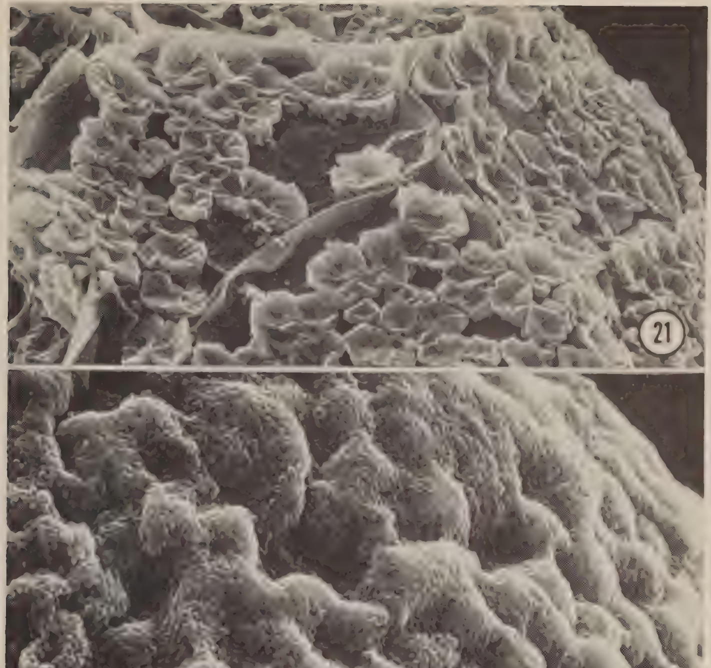
Table 1 indicates the average number of plasmodia and sporangia (or sporangial groupings) per plate at each temperature, on the five media employed, eight days after the spores were sown.

TABLE 1. EFFECT OF TEMPERATURE AND SUBSTRATUM ON PLASMODIAL FORMATION AND SPORULATION.

(Numbers of plasmodia and sporophores are averages for three plates.)

Medium	Structure	15 C	20 C	25 C
Lactose yeast agar	Plasmodia	--	14.6	20.6
	Sporophores	--	--	10.6
Plain agar	Plasmodia	--	--	2.0
	Sporophores	--	--	--
Bristol's agar	Plasmodia	--	3.0	10.3
	Sporophores	--	--	2.6
Corn meal agar	Plasmodia	--	12.3	18.6
	Sporophores	--	--	6.6
Half strength corn meal agar	Plasmodia	--	--	--
	Sporophores	--	--	--

Lactose yeast agar (LY) -- Lactose 1 g, Yeast extract 0.5 g, Agar 30 g.
Bristol's agar -- for formula see Bristol (1919).
Corn meal agar (CM) -- Difco corn meal agar prepared according to directions.
Half strength corn meal agar (CM/2) -- Equal quantities of Difco corn meal agar and plain agar.



Figures 21-23. SEMs of peridia of three species of Myxomycetes. 21. *Didymium trachysporum* G. Lister. X 1,060. 22. *Squamuloderma nullifila* Kowalski. X 1,800. 23. *Lepidoderma chailletii* Rost. X 325.

A number of natural substrata were also inoculated. These were pieces of bark or leaves from living trees as follows: bark of *Quercus virginiana*, *Pinus taeda*, *Carya pecan*; leaves of *Bauhinia* sp. All natural substrata were placed on filter paper in Petri dishes and, after autoclaving, were inoculated with a spore suspension of the myxomycete under study and with a few drops of *Enterobacter aerogenes* cell suspension. Sporangia were seen developing on these substrata eight days after inoculation; they had the same characteristics when mature as those developed on agar (Figures 1-3).

Effect of Light on Sporulation. The statement is often found in the literature that pigmented plasmodia require light for sporulation, but that white plasmodia do not (Gray and Alexopoulos, 1968). Gustafson (1973), however, showed that the white plasmodia of the particular strain of *Didymium squamulosum* (Alb. & Schw.) Fries he was studying would not form fruiting bodies in the dark. An experiment was performed, therefore, to determine whether our slime mold required light for sporulation.

One-tenth ml of an aqueous spore suspension containing 2.5×10^3 spores/ml was plated onto each of eight 60 X 20 mm Petri dishes together with a few drops of *Enterobacter aerogenes* cell suspension. Four of these contained LY agar and the other four CM/2 agar (Difco corn meal agar mixed with equal quantities of plain agar). All eight plates were placed in a light-tight box together with a small strip of unexposed 35 mm fast film to test for possible light leakage. The film was still unexposed at the end of the experiment. The box was placed in an incubator equipped with cool-white fluorescent tubes and programmed to maintain a temperature of 25 C. An identical set of plates was incubated next to the box on the shelf of the incubator.

All plates were examined after two weeks. Each was found to contain many sporangia. No significant differences were found in either the number or the morphology of the sporophores in the two sets of plates. It was concluded that this organism requires no light for sporulation. It will be remembered that in the experiment summarized in Table 1 the organism did not sporulate on CM/2 agar. In the light/dark experiment a number of sporophores were formed on this medium. We have no explanation for this discrepancy.

Effect of Substratum and Temperature on Taxonomic Characters. In accordance with the recommendations of Alexopoulos (1969) it was now imperative to test the stability of the major characters of the fructification and the spores before describing a new species.

A comparative study of the sporangia and spores produced on various substrata at 15, 20, and 25 C was undertaken to determine if the distinguishing characteristics of this organism remained stable under different conditions prevailing at the time of sporulation. Three types of agar and several natural substrata (bark and leaves from three species of trees, and pieces of wheat straw) were inoculated in triplicate and incubated at the three different temperatures listed above, in lighted incubators, after the spores had germinated at room temperature. *Escherichia coli* was used in these experiments as the associated organism.

Spore size and markings were quite uniform under all these conditions. The proportion of single sporangia to sporangial aggregates and the size of the sporophores varied in different plates but could not be correlated either with substratum or temperature, nor could differences in sporangial dimensions. Columella and capillitium were absent from all sporangia examined.

TAXONOMY

In view of the fact that the major characters used in classification were found to remain stable under a variety of environmental conditions on various substrata and have remained stable after more than 30 subcultures over 16 years, and inasmuch as the characteristics of this organism do not correspond to those of any known species of myxomycete, the description of a new species seems warranted.

Didymium atrichum M. R. Henney & Alexopoulos, sp. nov.

Sporangia sessilia, globosa vel plasmodiocarpa, dispersa vel fasciculata, 80-250 μm longa; hypothallus conspicuus, parce elevatus; peridium membranaceum, crystallis calcis obtectum vel conspersum; columella absens vel rudimentaria; capillitium absens; sporae globosae vel subglobosae, reticulatae, fuscobrunneae, 10-11 μm, diam.; phaneroplasmodium minutum, album. Holotypus = UTMC-1681

(TEX).

Didymium atrichum M. R. Henney & Alexopoulos, sp. nov.

Sporangia sessile, globose to plasmodiocarpous, scattered or clustered, 80-250 µm across; hypothallus conspicuous, gelatinous at first, slightly elevated when dry, sometimes resembling a short stipe; peridium membranaceous, sprinkled or covered with lime crystals; columella mostly absent, but sometimes rudimentary and then calcareous; capillitium totally lacking; spores mostly globose to subglobose, spinulose or faintly reticulate under the light microscope, but conspicuously reticulate under the scanning electron microscope, black in mass, dark brown by transmitted light, 10-11 µm diam., phaneroplasmodium remaining minute, milky white.

Etymology: Gr. *a* = without + *thrix* (*trichos*) = hair, *i.e.* without capillitium.

Holotype in the University of Texas at Austin Myxomycete Collection (TEX) as UTMC-1681. Cultotypes (mass spore transfers from a monosporous culture) in the National Fungus Collections (BPI); New York Botanical Garden (NY); American Type Culture Collection; Royal Botanical Gardens, Kew (K); Department of Botany, University of Helsinki; Facultad de Sciencias Naturales y Museo, La Plata, Argentina; and in the private collections of Dr. D. T. Kowalski, Chico, CA; Mme. E. N. Nannenga-Bremekamp, Doorwerth, Holland; and D. W. Mitchell, East Sussex, England.

In some sporangia of *Didymium atrichum* a calcareous mass at the base suggests a rudimentary columella reminiscent of that found sometimes in *Didymium trachysporum* G. Lister. This, and the fact that the latter species often has a scanty capillitium and spores on which the warts are often arranged in lines to form an inconspicuous reticulation, suggests a possible relationship between the two species.

There may be a difference of opinion among myxomycete taxonomists as to whether one of the Physarales without capillitium should be included in the genus *Didymium*. Kowalski (1972), for example, described the genus *Squamuloderma* chiefly on the basis of absence of capillitium from its didymioid sporangia. Alexopoulos (1976) criticized Kowalski's decision, pointing out that there are a number of *Didymium* species known to have a scanty capillitium and at least two species of *Perichaena* in which the capillitium is often scanty and occasionally lacking altogether (Martin and Alexopoulos, 1969). Our species could conceivably be classified in *Squamuloderma*, if that genus is recognized, except for the difference in the structure of the peridial lime. Kowalski (1972) described the lime of *Squamuloderma* as consisting of scalelike squamules, as the name of the genus indicates. We decided, therefore, to compare the lime of *Didymium atrichum* (cultotype), *D. trachysporum* (southwest Texas isolate by Mary R. Henney), *Squamuloderma nullifila* (subculture from a culture supplied by Dr. Kowalski), and *Lepidoderma chailletii* (UTMC-1110). Our results are depicted in the SEMs of Figures 12-14 and 21-23.

It was surprising to find that the lime of *Squamuloderma* was not in the form of scales, squamules, or crystals. The lime of *Didymium atrichum* in no way resembles that of *Squamuloderma* or *Lepidoderma*. It is closer to that of *Didymium trachysporum* in that both these species have lime crystals united laterally into flattened discs. This again supports the inclusion of *D. atrichum* in the genus *Didymium*.

We have decided that our species has its affinities with *Didymium*. We leave it to future taxonomists to rule whether our decision is the correct one.

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We thank Dr. Marie L. Farr for help with the Latin diagnosis, for suggesting the designation of cultotypes for specimens to be distributed, and for reviewing the manuscript before submittal to Mycotaxon. We also thank Dr. R. K. Benjamin, who was the second reviewer, for his critical comments.

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ARNIUM APICULATUM (SORDARIACEAE S. LAT.) REDISCOVERED

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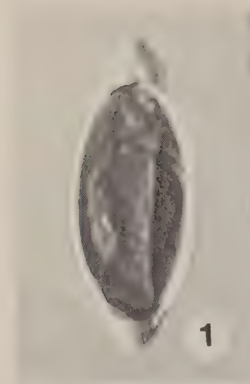
SUMMARY

Arnium apiculatum (Griffiths) Lundq., a species hitherto known only from the holotype collection made in 1898, has been rediscovered in the British Isles and in N. America. This species is described and illustrated in detail and compared with other species of *Arnium* sect. *Murnia* Lundq. A particular feature of this species is the presence of a conical apical process at each end of the spore. The ascospores are discharged forcibly by a subapical, circumcissile splitting and shedding of the upper part of the ascus (inclusive of a non-functional cylindrical apical apparatus).

Arnium apiculatum (Griffiths) Lundq. was first described by Griffiths (1901) as *Delitschia apiculata* Griffiths. He collected this fungus on dead stems of Russian thistle (*Salsola kali* L.) at Aberdeen, South Dakota, U.S.A., in March 1898. Lundqvist (1972) transferred this species to *Arnium* sect. *Murnia* Lundq. in the Lasiosphaeriaceae Chen. ex Nannf. (Sordariaceae s. lat.). *Arnium* Nitschke ex Winter is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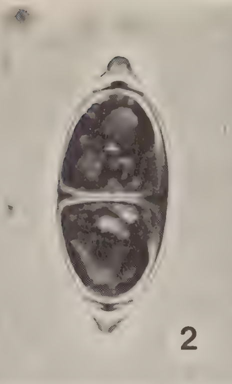
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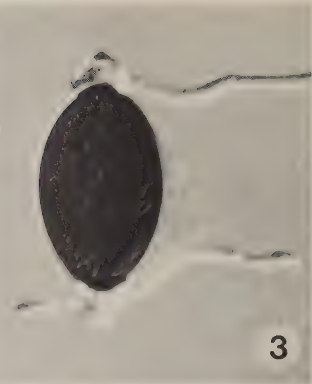
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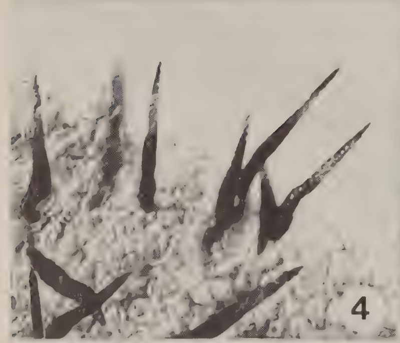
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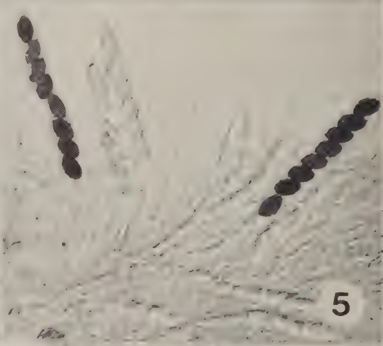
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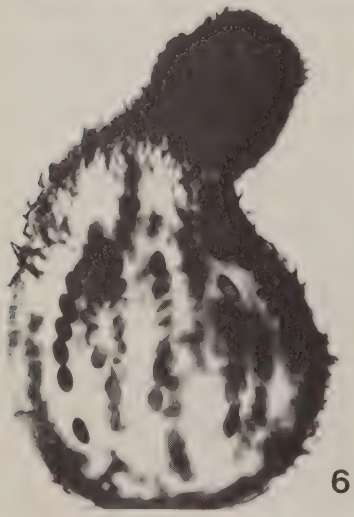
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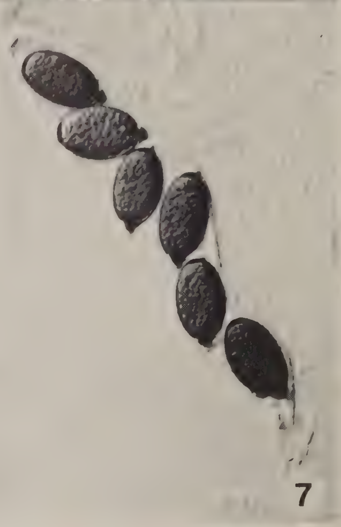
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distinguished from *Podospora* Ces. nom. cons. primarily by the ellipsoid to fusiform shape of the young ascospores; in sect. *Murnia* the spores are finally transversely 1-septate and bicaudate. Lundqvist noted that only three of the original slides, which are in poor condition, remain of the type material of *Arnium apiculatum*. This species was, however, isolated from ascospores of a perithecium on a dead stem of *Equisetum* sp. collected from an Illinois stream in 1978 and then incubated in a moist chamber. A further collection, evidently conspecific with these specimens, was discovered on dead *Heracleum sphondylium* L. stems in a marsh in Devon, England, the same year.

This paper records the discovery of this species and, with the additional material available, provides a fuller description and discussion of the affinities of this fungus than has hitherto been possible.

Arnium apiculatum (Griffiths) Lundq., *Symb. bot. upsal.* 20 (1): 243 (1972).

Delitschia apiculata Griffiths, *Mem. Torrey bot. Club* 11: 104 (1901).

Figs 1-18. Colonies on half-strength Emerson's yeast, peptone, soluble starch agar (YpSs/2) floccose, white, turning grey to blackish. Perithecia superficial, scattered or aggregated into small clusters, pyriform to subglobose, ostiolate, 0.4-1.3 x 0.2-0.5mm, covered with brown, thick-walled, straight or slightly curved, 0-1 septate hairs, 25-115 x 10-15μm, hairs more numerous in the neck region, with subhyaline to brown flexuose hyphae at the base. Peridium membranous, hyaline to greyish brown, semitransparent except for the dark brown opaque neck; peridial cells angular, pseudoparenchymatous, thin-walled, measuring about 2.5-15μm diam. Neck cylindrical to conical, periphysate, positively phototrophic, 200-550 x 150-250μm. Paraphyses hyaline, filiform, thin-walled, septate, often

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Figs 1-13, 15-18. *Arnium apiculatum* (ILLS). *Fig.* 1. Aseptate ascospore with appendages at both ends, x 1300. *Fig.* 2. Mature septate ascospore, x 1000. *Fig.* 3. Germinating ascospore, x 900. *Fig.* 4. Perithecial hairs and angular peridial cells, x 700. *Fig.* 5. Fascicle of asci and paraphyses, x 120. *Fig.* 6. Perithecium with a bent neck produced when under a unidirectional source of light, x 100. *Fig.* 7. Ascus containing non-septate ascospores and illustrating the thickened ascus tip, x 450.

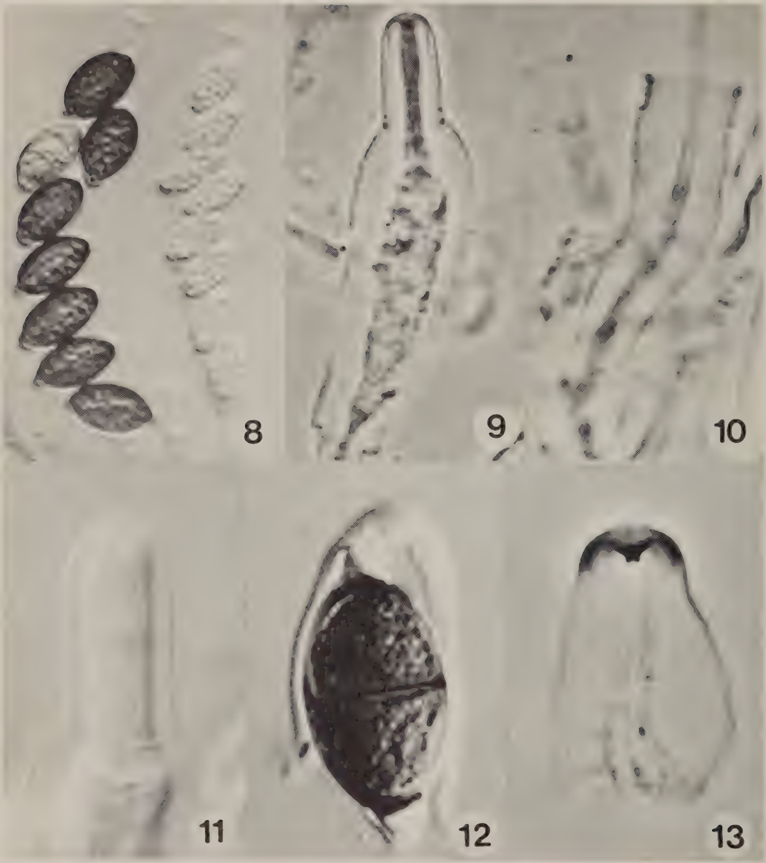

Fig. 8. Mature and immature asci, x 425. *Fig.* 9. Developing ascus illustrating the area of the ascus tip that will rupture, x 650. *Fig.* 10. Ascus after rupture of ascus tip and ejection of ascospores, x 900. *Fig.* 11. Ascus tip showing line of rupture, x 1200. *Fig.* 12. Ejected ascospore carrying the ascus tip, x 1500. *Fig.* 13. Ruptured ascus tip, x 1500.

longer than and mixed with the asci. Asci eight-spored, 150-250 x 15-50µm, unitunicate, cylindrical, narrowed and

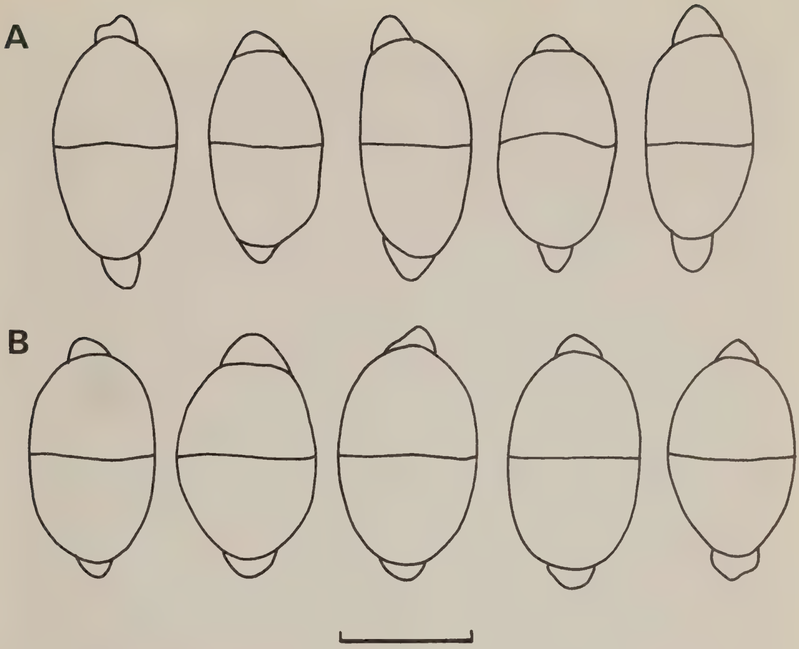

Fig. 14. Ascospore outlines. A, Illinois collection (IMI 238683). B, Devon collection (IMI 232650). Scale = 25µm.

somewhat rounded at the apices, tapering to a slender stipe 50-100µm long, non-amyloid, apical apparatus a cylinder with slightly concave sides, 7-21 x 4-9µm, thicker discharged, upper portion of the ascus rupturing from the basal portion along a predetermined circumcissile line. Ascospores obliquely uniseriate, sometimes biseriate, broadly ellipsoidal, (26-)30-35(-43) x (16-)17-23(-26)µm, hyaline with conspicuous oil droplets when immature, becoming dark brown and (0-)1-septate at maturity, ornamented with small rounded warts (SEM) but appearing smooth by LM; conical processes covering germ pores at both ends, 2.3-7.0µm long.

Specimens Examined: BRITISH ISLES, England: S. Devon, Mamhead, on dead *Heracleum sphondylium* stems, 1 September 1978, *M.B. & J.P. Ellis* (IMI 232650). -- U.S.A., Illinois: Vermilion Co., Jordon Creek, on submerged *Equisetum* sp., 29 May 1978, *C.A. Shearer J-4-1* (ATCC 38020, ILLS, IMI 238683, NY). South Dakota: Aberdeen, on *Salsola kali*, March 1898,

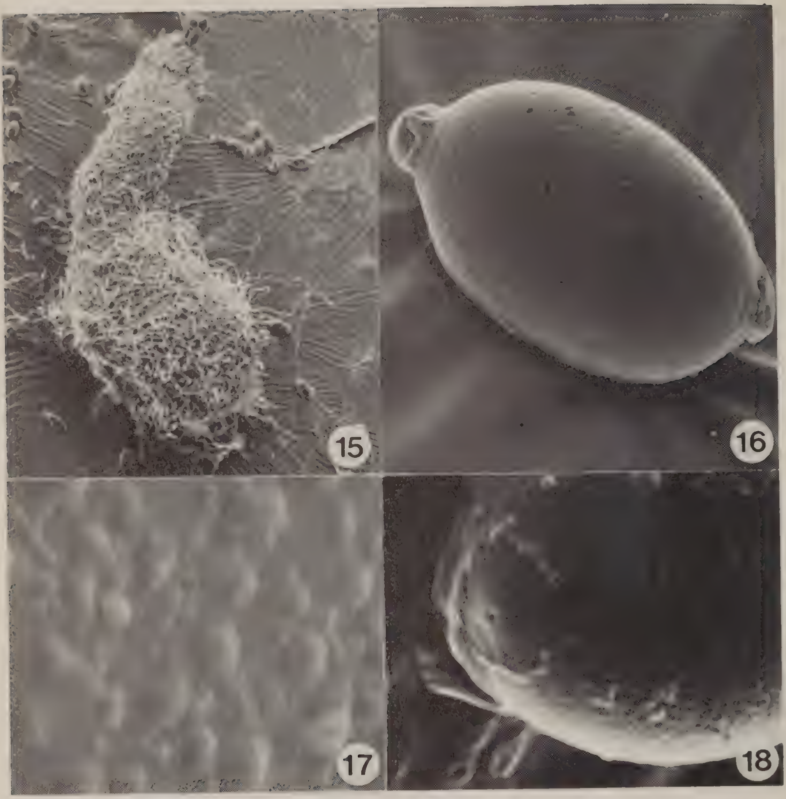

Fig. 15. Perithecium, SEM, x 95. *Fig.* 16. Ascospore, SEM, x 1030. *Fig.* 17. Ascospore surface ornamentation, SEM, x 6350. *Fig.* 18. Ascospore germ pore, the apical process removed, SEM, x 2600.

D. Griffiths (NY (3 slides only), holotype of *Delitschia apiculata* Griffiths).

The Illinois isolate appears to be identical to the type specimen, at least in ascospore morphology and size, although it should be noted that many immature spores in which the central septum has not yet developed occur in the type slides. The perithecia and asci of the type specimen are not well preserved but measurements and general morphology of this isolate agree well with those of the protologue. This isolate grows very well in culture on Emerson's YpSs/2 agar but reproduces much more abundantly when some type of plant substrate is incorporated into the medium.

Studies of the species in culture also showed that the neck of the perithecium is positively phototophic and will bend towards a unidirectional source of light (Fig. 6). Ascospores are forcibly discharged, usually in groups of eight. Griffiths (1901) described the asci as 'very evanescent' but did not discuss the process of ascospore discharge, which proves to be of particular interest. A circumcissile rupture occurs well below the ascus apex as the spores are forcibly discharged in a mass, often carrying the ascus cap with them (Figs 9, 11). The wall of the ascus is thicker above this line than below it (Fig. 7). Fig. 10 shows an ascus from which the tip has been ruptured, and Fig. 13 a ruptured ascus tip. A distinct apical cylinder can be seen in the tip of the ascus before and after discharge (Figs 7-9, 13). Discharging asci were observed more frequently when perithecia were allowed to dry slightly.

The British collection agrees in most details with the North American specimens, but the length:width ratios of the spores are slightly lower (Fig. 14). Spore measurements of the British material are 31-38 x 20-26µm, and of the N. American 26.5-43 x 15-23µm.

The processes at the ends of the spores were interpreted as gelatinous by Lundqvist (1972). However, they are apparently laid down at a very early stage of spore formation prior to the formation of the rounded ends which include the germ pore. Although rather constant in size and shape, these processes never seem to contain any protoplast material at ascospore maturity, and so we feel that they should not be regarded as cellular. By SEM, the outer covering of the processes appears discontinuous with that of the dark body of the spore (Fig. 16). The development of these processes is perhaps similar to that in other members of the Lasiosphaeriaceae Chen. ex Nannf., e.g. *Zopfiella lundqvistii* Shearer & Crane (Shearer & Crane, 1979). No TEM studies of appendage development in the Lasiosphaeriaceae appear to have been carried out but it would clearly be of interest to ascertain if the caudate appendages originated in a similar way in all genera of the family.

Arnium apiculatum was compared with the extant material of other species placed in sect. *Murnia* by

Lundqvist (1972), viz. *A. imitans* Lundq. (BP, holotype; UPS, isotype; BP and O, paratypes) and *A. septosporum* Lundq. (UPS, holotype; UPS, paratype). Neither of these species is known in culture and it proved impossible to deduce the method of ascus discharge from the slide preparations and very limited material available. The apical cylinder in the ascus tip of *A. apiculatum* is, however, identical to that in *A. imitans*; in *A. septosporum* rather few asci were in a suitable stage to observe the maturing asci in detail, but the apical cylinder appears to be shorter in that species. The appendages in both *A. imitans* and *A. septosporum* appear to lack a distinct internal channel. Further, as in *A. apiculatum* (Fig. 18), the appendages cover the apical germ pores (a single pore in the case of *A. septosporum*). All three species have similar perithecia, perithecial hairs, and spores in which the central dark cell becomes 1-septate at maturity.

These fungi clearly form a reasonably well circumscribed group within *Arnium* distinguished by (a) the apical cylinder of the asci, (b) the septate dark cell, (c) apical rather than excentric germ pores, and perhaps also (d) the unchannelled appendages (seen also in a few species of *Arnium* s. str.), and (e) the ornamented ascospore walls (Fig. 17). If the asci also discharge in a distinctive manner, it could be argued that the group might justify recognition at the generic level. However, we feel that it would be premature to do this until more information is available on the nature of the apical processes and discharge mechanisms in the family.

ACKNOWLEDGEMENTS

We are indebted to Dr N. Lundqvist for reading the manuscript and for his extremely helpful comments on our material, and further to the curators of the herbaria cited in the text (BP, O, UPS) for allowing us to study material in their care.

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MYCOTAXON

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ON AURIPORIA (APHYLLOPHORALES: POLYPORACEAE)

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The genus *Auriporia* was described as monotypic by Ryvarden for *Poria aurea* Peck in 1973. David, Tortic & Jelic described a new species, *A. aurulenta,* in 1974, and emended the diagnosis of the genus. The third species of the genus was found by the author in East Asia and will be described below. In contrast to the known species, it is pileate and has allantoid spores; consequently, the diagnosis of *Auriporia* must be emended once more.

AURIPORIA PILEATA Parm. sp. nov. - Fig. 1.

Basidiomata pileata, tenuia (ad 3 mm crass.), mollia, in state sicco levia. Superficies cremea, deinde luteo-aurantiaca, in alcalinis (KOH) rufescens. Contextus et tubuli cremei. Pori atrocremei, rotundo-angulati, 3.5-4 per mm. Systema hypharum monomiticum; hyphae generatoriae fibulatae. Cystidia fusoidea, inflata, apice muricellata (ubi ad instar *Inocybarum* concrescint cristalla), crasse tunicata, pedicellata, pedicellus usualiter basiramifer, 25-40 x 8-13 µm. Sporae allantoideae, 4.5-5.2 x 0.8-1.2 µm.

Typus: URSS, regio Primorsk, distr. Ternei, reservatum Sichote-Alinicum, ad caudicem arboris frondosae prolapsum putridum in populeto, leg. 19. IX 1976 E. Parmasto (Herb. Instituti Zoologici et Botanici, Tartu, no. TAA 52807).

Basidiomata pileate, sessile or with a decurrent resupinate base, sometimes attached by narrow base, solitary or imbricate, soft, light, 0.5-2 x 2-3 x 0.15-0.25 cm, when sideways concrescent up to 8 cm broad. Abhymenial surface nearly glabrous, in herbarium specimens slightly radiately rugose, indistinctly zonate, whitish cream or cream colour (Munsell: 2.5 Y 8.5/4; Kornerup & Wanscher: 4A4),[1] at the base or later totally luteous-orange or orange (7.5 -10 YR 7/12; 5A7), becoming vinaceous (2.5 R 5/8; 10C6) in KOH. Context white, slightly fibrous, 0.5-1 mm thick. Tubes 0.5-1.5 mm long, thin-walled, fragile when dry, concolorous with the pore surface. Pores quite regular, subangular, 0.2-0.25-(0.35) mm in diam., 3.5-4 per mm, with entire or only slightly dentate walls; pore surface pale

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[1] The colours have been noted according to Munsell, 1976, and Kornerup & Wanscher, 1967; the colur names are given after Rayner, 1970.

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luteous or cream (2.5 Y 8.5/4; 4A4).

Hyphal system monomitic; generative hyphae of the context rather densely interwoven, sparsely branched (some at clamps, some in a right angle), thin-walled or thick-walled, some almost solid, with frequent medallion clamps, 3-4.5 µm. Hyphae of the tube trama with thin or thickened walls and ordinary clamps, 2-3.5 µm. Cystidia numerous, of *Inocybe*-type: fusiform or broadly fusoid, sometimes quite irregular, rostrate, capitate-incrusted, thick-walled (walls up to 3 um thick), pedicellate, 25-40 x (6.5)-8-13 µm, projecting 10-20 µm from the hymenium; pedicel 2-3 µm in diam., with a clamp at the basal septum, up to 20-(60) µm long, near the base usually with 1 (rarely 2) short or rarely up to 18 µm long flexuous side branches. Basidia clavate, some slightly utriform, with clamps at basal septa, 15-20 x 4-5.5 µm, with (2) 4 thin, only slightly curved sterigmata 3.5-4 µm long. Spores cylindrical, curved (allantoid), smooth, hyaline, thin-walled, non-amyloid and non-cyanophilous, 4.5-5.2 x 0.8-1.2 µm.

Causes white fibrose rot; in the rotten wood there are scattered small patches of a luteous or orange mycelium.

Type: USSR, Primorskij Region, Ternejskij distr., Sikhote-Alinskij nature reserve area, on a fallen rotten deciduous trunk, coll. 19. Sept. 1967 E. Parmasto (TAA 52807 - holotype; isotypes in O and LY).

The species is related to *A. aurulenta* David, Tortic & Jelic, which differs in a resupinate habit, orange or golden yellow tube layer and pores, hyphae 2-3 µm in diam., only shortly pedicellate cystidia and ellipsoid spores 4.5-6 x 2-3 µm. *Tyromyces inocybe* David & Malenç. has cystidia similar to those of *A. pileata*, but differs in having a resupinate (or slightly reflexed) basidiome, smaller pores (4-5 per mm) and basidia (14.5-16 x 3.5-4 µm), and in slightly different spores 5-5.5-(6) x 1.4-1.6 µm.[2]

Including the new species, the genus *Auriporia* includes three species: *A. aurea* (Peck) Ryv., growing on coniferous wood in North America; *A. aurulenta* on coniferous, rarely on deciduous wood in Europe southwards of 50° N.L., and *A. pileata* on deciduous wood in East Asia; all species are rare or very rare. According to the original description, *Tyromyces inocybe* may also belong to the same genus. However, it was by David & Malençon (1978) compared with *Tyromyces simanii* (Pil.) Parm. The latter has non-inocyboid, non-pedicellate cystidia and seems to be a typical *Tyromyces* (cf. Parmasto, 1961).

Auriporia is a satellite genus of *Tyromyces;* the main difference is in the presence of *Inocybe*-like pedicellate cystidia and (in two species) the change of cream, yellowish or orange colour of basidiomata into red in KOH.

When *Tyromyces* has been revised and its circumscrip-

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[2] According to the data presented in the paper by David & Malençon, 1978 on p. 396, 406-407; in the table on p. 397 of the same paper the basidia are given as 14-18 (19) x 3.5-4.5 µm and spores as 4.5-5 (6) x 1.5-2 µm.

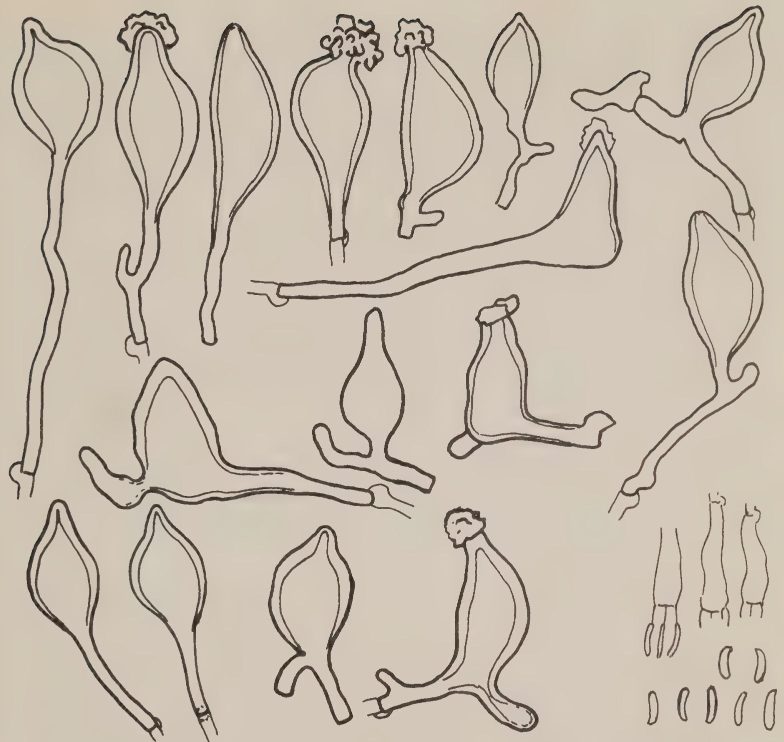

Fig. 1. Cystidia, basidia and spores of *Auriporia pileata*.

tion discussed, it may be that *Auriporia* ultimately will prove to be an arbitrary and superfluous genus, or the limits of *Auriporia* may be changed considerably. *Tyromyces* is still today quite heterogenous in spite of the exclusion of several heteromitic as well as dextrinous species.

The emended description of *Auriporia* and a key to the species known are as follows:

AURIPORIA Ryv., Norw. J. Bot. 20 (1): 2. 1973.

Basidiomata resupinate or pileate, lignicolous. Pores pale luteous, luteous or orange; the colour of basidiomata may turn red in KOH. Hyphal system monomitic; generative hyphae clamped. Cystidia numerous, inocyboid, thick-walled, fusiform, muricate, pedicellate, non-amyloid (and non-dextrinoid). Basidia clavate, with 4 thin sterigmata. Spores hyaline, thin-walled, smooth, non-amyloid, non-cyanophilous, ellipsoidal or allantoid (cylindrical).

1. Spores allantoid, up to 1.6 (? 2) µm in width . . . 2
- Spores ellipsoidal, with flattened side 3

2. Spores 4.5-5.2 x 0.8-1.2 µm. Pores 3-4 per mm. Basidiomata pileate, orange parts turn red in KOH . . . . *A. pileata.*
- Spores 5-5.5-(6) x 1.4-1.6 µm. Pores 4-5 per mm. Basidiomata resupinate or slightly reflexed, without colour change in KOH (?) . . . . *Tyromyces inocybe.*

3. Hyphae thin-walled, with clamps. Cystidia 22-35 x 9-15 µm, with one pedicel or non-pedicellate. Basidiome orange, turning red in KOH. Spores (4.5)-5-7-(8) x 2-3-(4) µm . . . . *A. aurulenta.*
- Hyphae thin-walled, with clamps, others thick-walled, with very rare clamps. Cystidia 20-50 x 14-30 µm, usually with a pedicel and one or several "roots". Basidiome yellowish, not changing colour in KOH. Spores (5)-7-9-(10) x 3-4-(4.5) µm . . . . *A. aurea.*

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A NEW SPECIES OF CRYPTOPHIALE FROM AMAZONAS

by

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Among the leaf-inhabiting fungi collected during an expedition of the Projeto Flora Amazonica, there is one which unmistakably belongs to the dematiaceous hyphomycete genus *Cryptophiale* Pirozynski, but does not fit any known species. The Amazonian fungus is distinguished by its relatively small dimensions (particularly of the conidia) and by variously shaped conidia, and is therefore described as a new species, *Cryptophiale minor*.

Cryptophiale minor sp. nov.

Etym. L. *minor* = smaller.

Mycelium reticulatum ex hyphis pallide brunneis vel subhyalinis ad 2 μm diam constans. Phialophora dispersa vel gregaria setiformia recta badia septata, 120-200 μm longa, 68 μm crassa, basi ad 14-20 μm expansa, apice acuta. Zona fecunda in dimidio superiore phialophori, 30-50 μm longa, 12-14(-16) μm lata; cellulis scutelli flavobrunneis cylindraceis vel lobatis 5.5-7.0 μm longis; phialidibus late ovoideis vel ampulliformibus pallide brunneis ca 3.0-5.5 μm diam composita. Phialosporae hyalinae uniseptatae, acerosae, falcatae, angustissime fusiformes, vel angustissime subulatae, 12-14(-16) μm longae, ad ca 1.2 μm latae guttulatae, apice attenuatae, basi attenuatae vel rotundatae.

Mycelium forming small light brown pellicles around the swollen base of the phialophore, elsewhere effusely reticulate, consisting of delicate hyphae nearly 2 μm in diam and pale brown near the phialophore base, becoming progressively narrower and paler. Phialophores scattered to gregarious, setiform, erect, dark reddish brown, 6- or more-septate (mostly in the upper zone), 120-200 μm long, 6-8 μm thick, flaring to a bulbous, dark basal cell 14-20 μm in diam. Fertile zone extending from just above the middle of the phialophore to within 18-32 μm of the sharply pointed apex, 30-50 μm long, 12-14(-16) μm wide (not including attached conidia); shield cells yellowish brown, cylindric to variously lobed, ca 5.5-7.0 μm long; phialides broadly ovoid to ampulliform, pale brown, ca 3.0-5.5 μm diam; conidia (phialospores) hyaline, 1-septate at or near the middle, straight or slightly curved, acerose to falcate or very narrowly fusiform or subulate, 12-14(-16)μm long, up to ca 1.2 μm wide, guttulate, attenuate at both ends or at the apex and then rounded at the base.

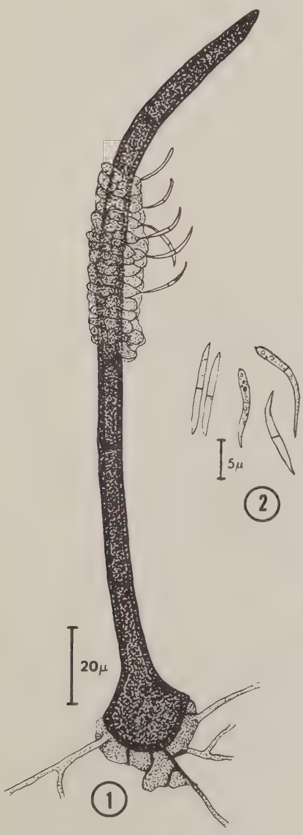
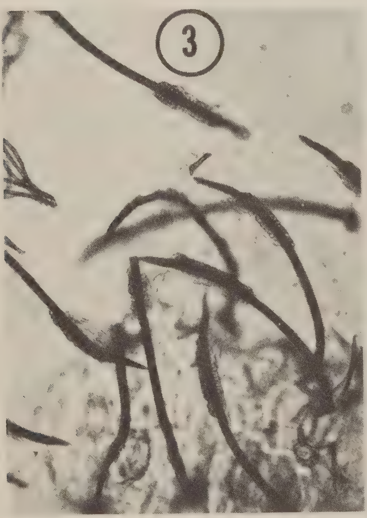


Fig. 1-4. *Cryptophiale minor*, from BPI isotype. Fig. 1. Fruiting body, semidiagrammatic; shield cells omitted from right edge to show phialides, X500. Fig. 2. Selected conidia, showing variation in shape, X1000 (guttules drawn in two). Both figs. prepared with aid of Leitz drawing tube. Fig. 3. Habit, ca X200, from celloidin strip. Fig. 4. Fruiting body, ca X350.

Holotype. Brazil: Amazonas, along the Rio Negro, near J. Bani (close to Vista Alegre), secondary on large zonate spots on dead leaves of *Astrocaryum* sp. (Palmaceae) 19 Jan, 1978, coll. I. Araujo & M. L. Farr (Farr AM-155), associated with *Acrotheca* sp., *Brooksia tropicalis* Hansf., and other fungi, BPI*; isotype, NY. Known only from the type collection.

The mucilaginous matrix of the conidia, one of the generic characters, was evident mostly as a dried or sticky coating on the fertile zone.

As shown in Table 1, *C. minor* has smaller conidia than each of the other five known species. In its remaining measurements, as well as in other morphological characteristics, it appears to be closest to *C. iriomoteana* Mats. The conidia of the latter species, however, are not only larger, but (judged from the illustrations in the protologue) consistently subulate, and



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*Originally designated holotype of INPA destroyed by fire while this paper was in preparation.

Table 1. Comparison of Cryptophiale spp.

Species	Phialophores	Fertile Zone	Shield Cells	Phialides	Conidia	Locality	Substrate
kakombensis Pirozynski, Can. J. Bot. 46: 1124-1125. 1968. (type species)	150-260 x 5-8 µm, apex simple	100-110 x 16-22 x 10-15 µm	10-14 x 3.0-3.5 x 11-15 µm	no measurements given; lageniform	22-27.5 x 1.7-2.0 µm, curved, falcate	Tanzania	fallen leaves of Baphia.
udagawae Piroz. & Ichinoe in Pirozynski, Can. J. Bot. 46: 1126. 1968.	to 250 x 5-8 µm, apex 1-3 times dichotomously forked	70-100 x 15-27 x 13-19 µm	10-13 x 3.5 x 13-16 µm	no measurements given; subglobose	15-25 x 1.5-3.0 µm, curved, narrowly subulate, apex drawn out into a short appendage	Japan	fallen leaves of Quercus.
guadalcanalensis Matsushima, Microfungi Solomon Isls. & Papua-New Guinea pp. 15-16. 1971.	170-240 x 6-8 µm, apex 1-2 times forked	70-90 x 13-16 µm	not described	not described	16-24 x 1.3-2.0 µm, curved, subulate	Solomon Isls.; Okinawa	rotten leaves of Pometia Castanopsis
iriomoteanum [sic] Mats. Ic. Fgi. Matsushima Lect. p. 41. 1975.	120-200 x 5-7 µm, apex simple	40-80 x 12-16 µm	not described	hyaline, no shape or measurements given	14-23 x 1.5-2.0 µm, curved, narrowly subulate, with hooked apex ["narrowly obclavate"]	Okinawa	dead hardwood bark
manifesta Sutton & Hodges, Nova Hedwigia 27: 350. 1976.	to 250 x 4.0-6.5 µm, apex simple	31.5-70.0 x 10.5-17.0 x 2-6 µm	not described	4-12 x 2.5-3.5 µm, lageniform w. collarette, polyphialidic, conspicuous	22-27 x 1.5-2.0 µm, straight, narrowly subulate	Brazil	Dead leaves Eucalyptus
minor sp. nov.	120-200 x 6.8 µm, apex simple (but see text)	32-48 x 12-14 (-16) µm	5.5-7.0 µm long	ca 3.0-5.5 µm broadly, ovoid to ampulliform	12-14(16) x up to ca 1.2 µm, acerose or falcate to narrowly fusiform or subulate	Brazil	dead leaves of Astrocaryum Astrocaryum

appear more strongly curved, even hook-like at the apex. The Okinawan species also has a larger fertile zone and is unique in its habit on bark.

The variability of conidial shape shown by *C. minor* is an unusual feature since conidial shape appears to be uniform in the other species of *Cryptophiale*.

With respect to structure of the phialophore apex, the species of *Cryptophiale* fall into two groups (see key). Although the new species definitely belongs to group 1', one phialophore was observed to be split at the very tip into two small branches 10 μm long and 2.0-2.5 μm thick.

The following key is based on the illustrated descriptions of the species of *Cryptophiale*.

1. Apex of phialophore branched........................2
1'. Apex of phialophore simple, pointed................3

2. Fertile zone extending into first dichotomy of phialophore apex; conidial apex gradually tapered
.... *C guadalcanalensis*
2'. Fertile zone confined to unbranched portion of phialophore; conidia abruptly narrowed to an almost appendage-like, curved apex............. *C. udagawae*

3. Conidia mostly 12-14 μm long............... *C. minor*
3'. Conidia mostly 14-27 μm long...................... 4

4. Conidia 14-23 μm long; on bark........ *C. iriomoteana*
4'. Conidia 22-28 μm long; on leaves...................5

5. Conidia falcate, tapered toward both ends; fertile region near tip of phialophore, 100-110 x 16-22 x 10-15 μm............................. *C. kakombensis*
5'. Conidia narrowly subulate, tapered toward one end, broadly rounded on the other; fertile region median along phialophore, 31.5-70.0 x 10.5-17.0 x 2-6 μm....
.... *C. manifesta*

ACKNOWLEDGMENTS

I thank K. Pirozynski for constructive criticism and most helpful suggestions concerning the manuscript, and G. Papavizas for assistance with Greek etymology. The fungus described in this paper was collected during my participation in Projeto Flora Amazonica, NSF Grant INT77-17704.

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A NEW SPECIES OF *EXOPHIALA* RECOVERED FROM LOBLOLLY PINE LITTER

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ABSTRACT

Exophiala dopicola Katz et McGinnis, sp. nov. is described from *Pinus taeda* L. needle litter in North Carolina.

INTRODUCTION

While studying *Pinus taeda* L. (loblolly pine) needle litter decomposition in age stratified plots, an interesting dematiaceous hyphomycete was repeatedly isolated from two to seven year old litter. A careful study of this hyphomycete, as well as the type cultures of all of the accepted species of *Exophiala* Carmichael, has revealed that this fungus is undescribed.

TAXONOMIC PART

Exophiala dopicola Katz et McGinnis, sp. nov. (figure 1).

Coloniae in agaro cum malto composito satae sub calore 20-23°C die quinto decimo diametrum 7-8 mm attinentes, in medio floccosae, leves prope margines, atro-fuscae vel atro-olivaceae (sensu Ridgway). Hyphae aereae leves, usque ad 3 µm crassae, cellulis 8-18 µm longis; submersae leves, cellulis at 3 µm crassis, 7-15 µm longis, sterilibus. Conidiophori micronemati vel semi-micronemati. Cellulae conidiogenae annellides, proxime in hyphis haud transformatis vel in apicibus catenularum brevium hypharum toruloidearum suffultae. Annellides nonnumquam percurrenter proliferantes. Annellidum venter subglobosus vel ellipticus, 3-5 X 7-12 µm, collum ad 15 µm longum, pallide brunneum. Annelloconidia cylindrica, cicatrici basali stricta notata, 1.5 - 2.5 X 6-11 μm, levia, unicellularia, in globis cumulata, hyalina vel pallide brunnea. Sub calore 37°C nullus auctus et nullae cellulae blastogenae.

Habitat: On decomposing needles of *Pinus taeda* L.

Holotypus: BAK 978, collected from *P. taeda* stand, the Duke Forest, Orange county, North Carolina, October 22, 1977, by B. Katz. The holotype and a living culture will be maintained at the National Fungus Collection, Beltsville, Maryland. Additional living cultures maintained in the Culture Collection, North Carolina Memorial Hospital, Chapel Hill, North Carolina. The epithet *dopicola* was invented and has no historic derivation.

Colonies attaining a diameter of 7-8 mm at 20-23°C on malt agar in 14 days. Colonies floccose in the center, flat at the margins, fuscous-black to olivaceous-black (Ridgeway). Aerial hyphae smooth, up to 3 μm wide, and 7-15 μm long and sterile. Conidiophores micronematous to semimacronematous. Conidiogenous cells are annellides, borne directly on unspecialized hyphae, or at the apices of short chains of toruloid hyphae, or both. Annellides occasionally proliferate percurrently. Annellide venter subglobose to elliptical, 3-5 X 7-12 μm, neck up to 15 μm long, pale brown. Anelloconidia cylindrical, with narrow basal scar, 1.5 - 2.5 X 6-11 μm, smooth, 1-celled, accumulating in balls, hyaline to pale brown. Growth at 37°C and yeast cells are absent.

DISCUSSION

The genus *Exophiala* was established by Carmichael in 1966 (2) to accommodate *E. salmonis*, a pathogen of fish. Subsequently, several additional species have been added to the genus *Exophiala* (1, 3, 5). *Exophiala dopicola* is the only member of this genus that has not been reported to be a pathogen of man or animals (4, 6).

Exophiala dopicola differs from the other species of *Exophiala* by its 1-celled, cylindrical annelloconidia and the absence of yeast-like cells. Isolates of *E. dopicola* have been repeatedly collected from two to seven year old litter throughout the study. In addition to the Duke Forest site, this taxon has also been recovered in a *P. taeda* stand at Saxapahaw, Alamance County, N.C. The fungus is rather common in these sites and is represented by approximately 200 isolates.

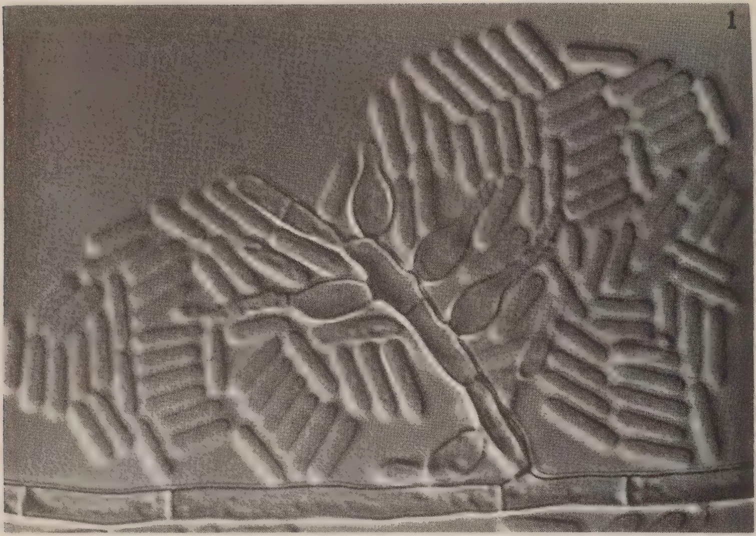

Fig. 1. Annellides of different ages and annelloconidia, 500X.

ACKNOWLEDGEMENT

We would like to thank Dr. D. P. Rogers for reviewing the manuscript and preparing the Latin translation of the diagnosis.

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LYCOPERDON NETTYANA, A NEW PUFFBALL FROM WESTERN WASHINGTON STATE

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DESCRIPTION

Lycoperdon nettyana sp. nov.

Gasterocarpia 2-3 cm lata, 3-4 cm alta, stipitato-subcapitata, ad apicem rotundata, mediobrunnea, pannos granulosos granulis *Lycoperdontis pyriformis* similibus sed parvioribus et regulatioribus praebens, quos colori brunneo apicis modificationem dilute griseibrunneam donant. Exoperidium e granulis, prominentias breves et conicas, vel globuliformes constans; prominentiae per radandum sed haud terendum effractae, cicatrices rotundatas depressas facientes. Exoperidium in maturitate ad apicem gasterocarpii irregulariter findens et exutum, endoperidium nitentem, laevem, persistentem exhibens; post iacturam exoperidii porus apicalis circularis facitur. Stipes basem versus angustatus, ad substratum per rhizomorphas albas colligatus, pallidus, prominentiis granulisque ad aspectu glandularum reductis, a stipitem pallidum fuscatis videntur.

Gleba omnis pluricellulosa in parte basali sterili et parte apicali fertili divisa. Pars basalis e cellulis minus quam 1 mm diam constans quae inter partes basales et apicales dissepimentum e cellulis complanatis faciunt; dissepimentum in partem fertilem 2 mm ad modum tholi extensum, area fuscata infra tholum ostendens. Gleba fertilis griseibrunnea vel mediobrunnea, e cellulis parvibus et irregularibus, ante aperturiem pori apicalis pseudocolumellam praebens, quam e fasciculum verticalem tubulorum angustorum constat. Sporae globosae, apedicellatae, verruculosae, 4-5 m diam. Capillitium 6 m diam, pariete 1.2 m crasso, foveas circulares parietis et ramulos latiangulos interdum praebens.

Gasterocarpia dispersa vel caespitosa in solo propatulorum sylvarum. Holotypus L-X1 ad castram Iron Springs dictam prope Cispus comitato Lewis pagi Washingtonis 22 Oct 77 a Netty Laycock lectus, in herbario Universitatis Washingtonis conservatus.

Gasterocarp 2 to 3 cm broad, 3 to 4 cm high, stipitate-subcapitate with upper portion hemispherical, medium brown, covered with small, (more or less) regular granular patches that impart light grayish brown color (60, see Kelly,1965); granular exoperidium interspersed with short conical spines and rounded buttons about 2 mm apart. Exoperidium at maturity splitting irregularly across the apex and peeling or flaking away. Endoperidium, when exposed, lustrous,smooth, light grayish yellowish brown (79), persistent; apical pore soon forming, circular, less than 1 cm diam. Pseudostipe tapering to base, attached to substrate by white rhizomorphs; surface pallid with scattered dark granules and reduced gland-like projections.

Subgleba whitish, pigmented in uppermost 5 mm, with empty loculae less than 1 mm across; distinctly separated from gleba by a thin layer of collapsed loculae which is centrally elevated about 2 mm at the base of the pseudocolumella. Gleba grayish brown (61) to moderate brown (58) near or at maturity, with a distinct pseudocolumella (see photo) rising to near the apex. Spores globose, apedicellate, verruculose, 4-4.5 um in diam. Capillitium 6 um in diam., walls up to 1.2 um thick with occasional circular pitting, few wide angle branches.

Collected on soil in woodland clearings, scattered to cespitose, autumn. Holotype, L-X1, collected by Nettie Laycock at Iron Springs Campground 5 miles from Cispus Environmental Learning Center, Lewis Co., Washington, 22 Oct 1977. Stored in University of Washington Herbarium.

DISCUSSION

During the production of a trial key for the Lycoperdales reported for the Pacific Northwest, this puffball was brought to me by Nettie Laycock at the Cispus III Foray. I was not able to match it with any of the reported Northwest species nor with the publications by Dr.Alexander Smith. I sent a sample to Dr. Smith for his opinion and he reported to me that Vincent DeMoulin of Liege, Belgium, has classified it as a western variant of _Lycoperdon pyriforme_ Schaeff per Pers. However, this specimen has significant differences from _L. pyriforme_ which indicate that it should be accorded full rank as a species. These differences are:

1. _L. nettyana_ is covered with granular patches similar to but smaller and more regular in size than _L. pyriforme_.
2. _L. pyriforme_ does not slough away the exoperidium. The scales and granules dry on the surface of the endoperidium to produce a sandpapery texture.
3. _L. pyriforme_ is always found on wood or wood debris. _L. nettyana_ was found on soil.

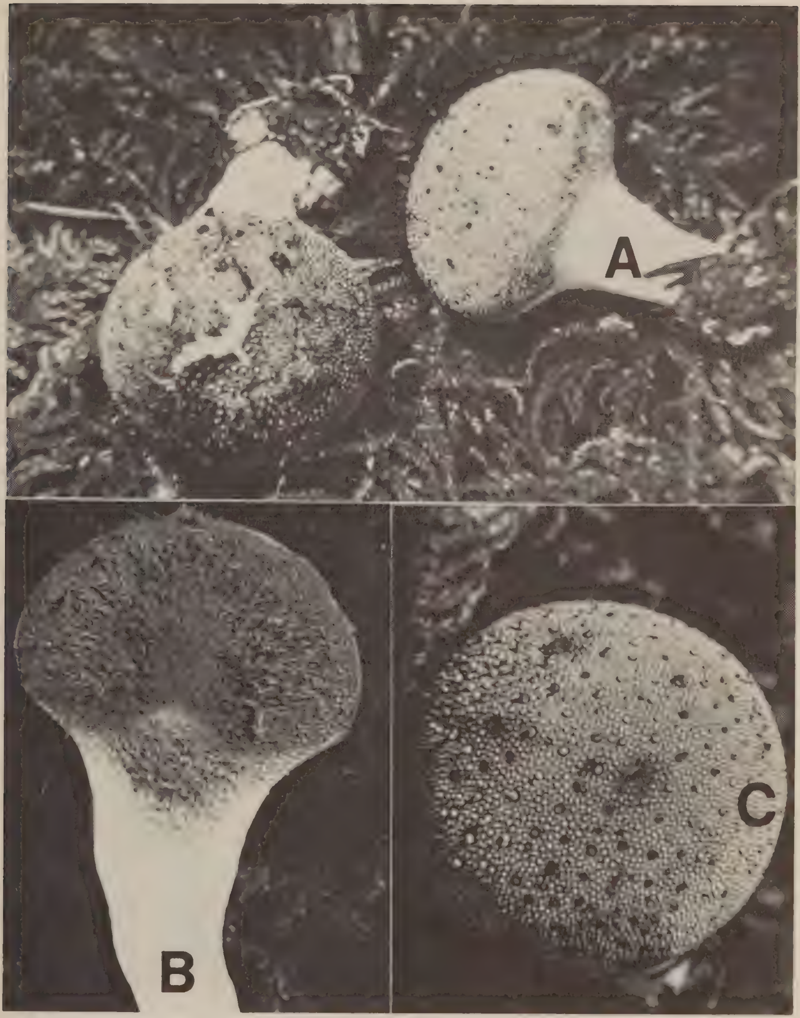

Figure A, left sporocarp with splitting exoperidium.

Figure B, longitudinal section showing discolored area of sterile base and pseudocolumella. Note pore formation at apex.

Figure C, typical exoperidial texture showing spines and buttons. Missing ones were scraped to remove.

Photos by Joy Spurr

4. L. pyriforme does not exhibit a distinct pseudocolumella, nor a sharp division between sterile and fertile tissues, nor a discolored zone below the division.

5. L. pyriforme has spores 2.8 to 3.5 microns while L. nettyana has spores from 4 to 4.5 microns in diam.

6. L. pyriforme forms an irregular pore slowly while L. nettyana forms a circular pore soon after loss of the exoperidium.

Some of these differences could be ascribed to individual variations or climatic and geographic influences, but the second, fourth and fifth points seem unassailable.

There is a superficial resemblance of the exoperidium to Lycoperdon perlatum Pers. but the spines and buttons must be scraped to loosen. Of some two dozen Lycoperdon species described in the U.S., only three others appear to lose the exoperidium by peeling or flaking. L. curtissi Berk. lacks a sterile base. L. rimulatum Peck has a smooth exoperidium. L. marginatum Vitt (L. candidum Pers per Pers.) is not stipitate and its sterile base has much larger loculae. Taken together, all these points lead to the conclusion that Lycoperdon nettyana has heretofore been undescribed.

ACKNOWLEDGMENTS

The author wishes to thank Dr. Daniel Stuntz of the Botany Department of the University of Washington and Dr. David Hosford of Central Washington University for their assistance and criticisms. Also Nettie Laycock for her interest in my area of mycology while engaged in her own study of other genera.

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STUDIES IN THE HYALOSCYPHACEAE I: SOME SPECIES OF DASYSCYPHUS ON TROPICAL FERNS

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SUMMARY

The six most common species of *Dasyscyphus* S.F. Gray, on tropical ferns are described and illustrated. They fall into two groups. One contains *D. ulei* and *D. chermisinus*, the other *D. fimbriifer*, *D. varians* and related taxa. *D. fimbriifer* var. *brevisporus* is raised to specific rank, and *D. singerinus* is reduced to a variety of *D. fimbriifer*, *D. pteridophyllus* to a variety of *D. varians* and *Arenaea macrospora* to a variety of *D. oncospermatis*.

Decaying ferns are the preferred substrate for a large number of microfungi (Holm & Holm 1978, Bϕhler 1974). Amongst the most prevalent and conspicuous of these are the brightly colored Hyaloscyphaceae on large tropical ferns. During the study of many collections made by the author and others connected with the Flora Neotropica Project, it was found that most collections on ferns are related to *Dasyscyphus varians* Rehm but with wide variations in spore, hair and ascus size and pigmentation of the apothecia. Type specimens of fern inhabiting taxa from all tropical regions were examined, where available, in order to determine the correct names for these taxa. Several species were reduced to varietal rank and one variety raised to specific rank in an attempt to better reflect natural relationships. A second, smaller natural grouping of species related to *Dasyscyphus ulei* (Wint.) Sacc. is discussed in part here, but other species in this group characterized by bright red discs occur on superficially similar, but phylogenetically unrelated, palm fronds and are outside the scope of this study.

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Key to Common Dasyscyphi on Tropical Ferns

1. Species with bright red discs and white hairs.........2
1. Species with cream or yellow discs and white or yellow hairs..3
    2. Spores 18-30 x 0.6-0.9 µm, on non-living petioles of large ferns.........2. *D. chermisinus*
    2. Spores 10-20 x 1.7-2.3 µm, on pinnae of living *Gleichenia*............1. *D. ulei*
3. Hairs hyaline, without colored matter at the tips, often over 125 µm long, tapered............................4
3. Hairs straw-colored, with amber to garnet-colored matter at the tips, usually cylindrical, under 100 µm long...6
    4. Hairs up to 600 µm long, spores 10.5-12.7 x 1.8-2.0 µm............5. *D. brevisporus*
    4. Hairs less than 350 µm long.......................5
5. Spores 6-12 µm long.......4. *D. fimbriifer* var. *singerianus*
5. Spores 13-30 µm long......3. *D. fimbriifer* var. *fimbriifer*
    6. Spores under 18 µm long, stipes not branched, apothecia not convoluted..........................7
    6. Spores over 18 µm long, stipes some times branched, apothecia some times with convoluted margins.......8
7. Spores 6-11 µm long with rounded apices..6. *D. varians* var. *varians*
7. Spores 11-18 µm long with acute apices...7. *D. varians* var. *pteridophyllus*
    8. Spores 20-32 µm long...8. *D. oncospermatis* var. *oncospermatis*
    8. Spores 35-65 µm long...9. *D. oncospermatis* var. *macrosporus*

1. *Dasyscyphus ulei* (Wint.) Sacc., Syll. Fung. 8:452. 1889. Fig. 1.

≡*Peziza ulei* Wint., Hedwigia 24:258. 1885.
≡*Atractobolus ulei* (Wint.) O. Kuntze, Revis. Gen. Pl. 3(2):446. 1889.
=*Dasyscyphus dicranopteridis* Seaver & Whetzel, Sci. Surv. Porto Rico 8:74. 1926.
≡*Lachnella dicranopteridis* (Seaver & Whetzel) Seaver, N. Amer. Cup-Fungi, Inoperculates p. 262. 1951.

TYPE COLLECTION - E. Ule, 1884, São Francisco, Santa Catharina, Brasil. Distributed as number 3273 in Century XXXIII of Winter's *L. Rabenhorstii Fungi Europaei et Extra-europaei exsiccati.* This exsiccatum was not reexamined by the author as it has been adequately described elsewhere (Dennis, 1954).

Apothecia seated on darkened pinnae of living fern fronds, goblet-shaped, short-stipitate, up to 0.5 mm across, scarlet-red with white to pink hairs forming a stiff, short, vertical fringe at the margin of the cup; disc scarlet-red, concave, exposed even when dried. Pigment diffusing, turning purple-violet then colorless when placed in 3% KOH. Hairs to 125 μm x 2.5-4.0 μm, generally much shorter, cylindrical with hemispherical or slightly tapered tip, hyaline, thin-walled, straight or slightly curved when dry, flexuous in aqueous solutions, densely roughened throughout their entire length with minute granules. Granules up to 0.3 μm long, slightly longer than broad, appearing perpendicular to the surface of the hair, hyaline, insoluable in 3% KOH. Ectal excipulum composed of short-celled textura prismatica, cells 4-10 by 3-6 μm, becoming textura angularis to globulosa in some portions of the cup, hyaline (after pigment decolorizes in KOH), with walls up to 1 μm thick. Asci cylindrical with a slightly tapered base, (35-) 43-70(-80) by 3.5-6.0(-8) μm and hemispherical apex with a small but distinct pore plug staining as a tapered cylinder in IKI with KOH pretreatment, no croziers present. Spores 10-18(-22) by 2.0-3.0 μm, nonseptate, hyaline, smooth, tapered toward both ends, slightly curved along the longitudinal axis, without distinctive inclusions. Paraphyses hyaline, narrowly lanceolate, 2-3 μm at the widest point about 1/3 below the tip, tapered to a rounded apex ca 1 μm broad, exceeding the asci in the hymenium by up to 20 μm, septate in the lower portion only.

HOST - Only known from dead pinnae on partially living fronds of *Gleichenia* (=*Dicranopteris*)

RANGE - Known only from Brasil, Peru and Puerto Rico.

ETYMOLOGY - After the collector Ernst Heinrich Ule, a German born naturalist who spent most of his career in Brasil. (Stevenson, 1971).

PREVIOUSLY PUBLISHED ILLUSTRATIONS - None.

SPECIMENS EXAMINED - Brasil: A.S. Costa, 6.IX.36, as White Herbarium 3439 and CUP 27983, Porto de embarque Ubatuba, S. Paulo, determined by H.H. Whetzel and W.L. White, on pinnae of fern which appears to be *Gleichenia* (FH). Peru: E. Ule, Oct. 1902, as Herbarium Brasiliense 3310, Cerro de Cumbaso, on *Gleichenia dichotoma* (FH). Puerto Rico: H.H. Whetzel, Kern & Toro P.R. Fungi 2683, CUP 14742, July 18, 1924. Finca Maria, Yáuco. Holotype of *D. dicranopteridis* Seaver & Whetzel (CUP).

DISCUSSION - *D. ulei* is the most commonly collected member of a group of Dasyscyphi with bright red hymenia and pink appearing hairs. It is apparently found only on dead portions of living fronds of *Gleichenia*. This kind of association with living plants is also found in the unrelated temperate species *D. gaultheriae* (Ellis & Everh.) Sacc. which occurs on grey spots of *Gaultheria shallon*.

Variation in spore length among the known collections is from 10 to 22 µm, but since they are all on the same host and the size does not seem to correlate with any other characters, all will be treated as the same species including the type collection of *D. dicranopteridis* Seaver & Whetzel.

A related and apparently unnamed species commonly occurs on palm fronds.

2. *Dasyscyphus chermisinus* Cash, J. Wash. Acad. Sci. 48: 256. 1958. Fig. 2.

HOLOTYPE - E.J.H. Corner 1225, December 19, 1948, Corcorvado Rio de Janeiro, Brasil, on *Alsophila* petioles. (BPI).

Apothecia macroscopically identical to *D. ulei* and with the same pigment change in KOH. Hairs also the same. Ectal excipulum composed of hyaline, indistinct, long-celled textura prismatica with light straw colored irregular cells on the surface. Asci 40-45 x 3.5-5.0 µm, hyaline,

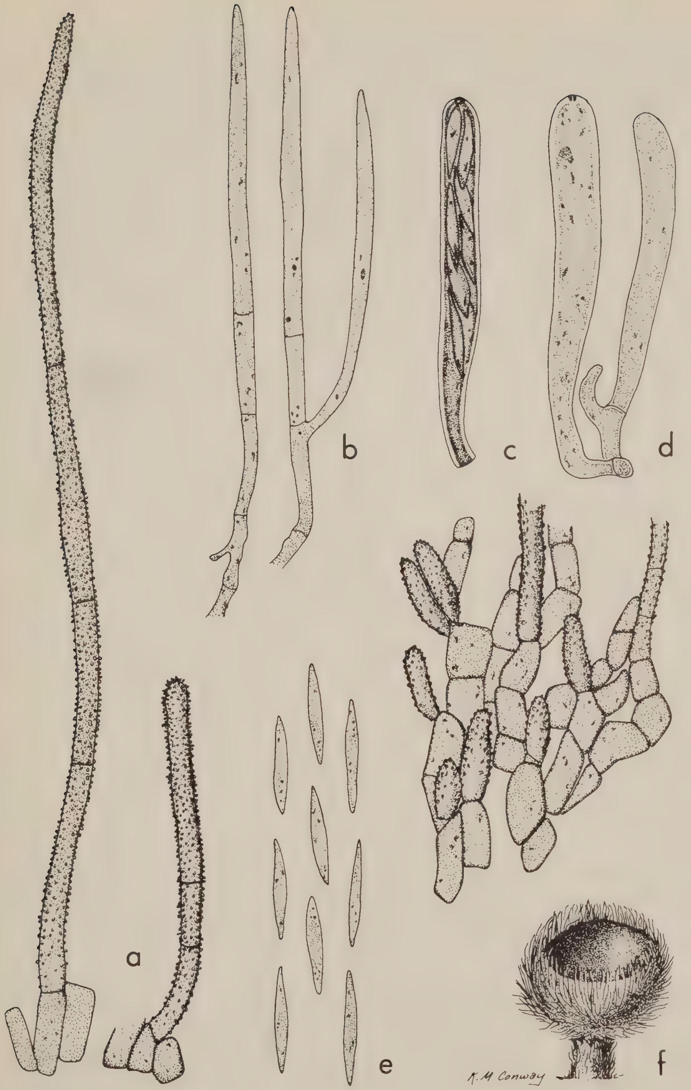
a
b
c
d
e
f
K.M Conway

Fig. 1. *Dasyscyphus ulei*, a. hairs, b. paraphyses, c. asci, e. spores, d. surface view of ectal exciple, f. apothecium. From White #3310. a-e 1320X, f. approx. 30X.

cylindrical, 8-spored, with a J+ pore plug visible unstained with phase microscopy as a tapered cylinder, tapered toward the base which has no apparent crozier. Spores 18-30 x 0.8-1.1 µm, cylindrical with bipolar symmetry, non-septate, hyaline, flexible, often geniculate, without conspicuous inclusions. Paraphyses very narrowly lanceolate, barely exceeding the asci in the hymenial arrangement, 1.2-2.0 µm diam. at the widest point, tips rounded, 0.5-1.0 µm wide.

HOST - As yet only known from petioles of the large fern *Alsophila*.

RANGE - Known only from the type locality, Rio de Janeiro, Brasil.

ETYMOLOGY - From Latin Chermisino = Blood-colored, the color of the disc.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - None.

SPECIMENS EXAMINED - Holotype (BPI).

DISCUSSION - Although this species is still represented by only one collection, it appears to be distinct. It has an obvious relationship to *D. ulei* but differs in spore shape and substrate.

3. *Dasyscyphus fimbriifer* (Berk. & Curt.) Sacc., Syll. Fung. 8:452. 1889. var. *fimbriifer*

≡*Peziza (Dasyscyphae) fimbriifer* Berk. & Curt., J. Linn. Soc. Bot. 10:377. 1868.
≡*Atractobolus fimbriifer* (Berk. & Curt.) O. Kuntze, Revis. Gen. Pl. 3:445. 1898.

TYPE - Charles Wright 654. Cuba, December. Holotype: Herb. Berkeley (K); Isotype: Herb. Curtis (FH). The Farlow Herbarium specimen also bears the designation "B&C Fungi Cub. 681" which is merely the species number in the publication. Both the holotype and isotype collections contain only a few immature or damaged apothecia.

Apothecia up to 0.6 mm in diam., stipitate, superficial, wine glass-shaped, light cream-colored, covered with long, bright white hairs without lumps of colored,

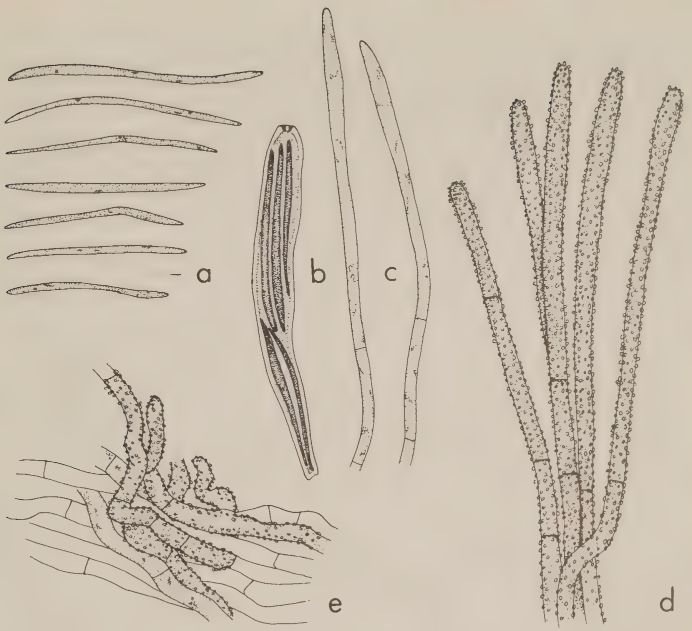

Fig. 2. *Dasyscyphus chermisinus*, a. spores, b. asci., c. paraphyses, d. hairs, e. surface view of exciple. From the holotype 1370X.

resinous matter; disc cream-color, exposed when moist, covered by hairs when dry; opening when rehydrated; hairs of different lengths, the longest to 350 x 4-6 μm, often tapered to 3-4 μm toward the apex and base, hyaline, thin-walled but rigid, septate at 12-30 μm intervals, ornamented on the surface with rod-shaped granules up to 0.5 μm in height and slightly less in diam. The granules appear to be slightly slanted toward the apex of the hairs; shorter hairs are similar, but usually cylindrical. Asci 60-85 x 6-8 μm, cylindrical, with hemispherical to conical apices and tapered bases, 8-spored, with obvious pore and tapered, J+ plug 1.5 μm long, 1.0 μm wide at the top, visible with phase optics as a tapered tube, croziers not observed, arising from a subhymenium of textura intricata. Spores (13-)15-28(-32) x 2.0-3.0(-3.7) μm, fusiform with rounded tips about 1 µm broad, and with nearly bipolar symmetry, non-septate, or rarely 1 or 3 septate, often with refractile inclusions almost filling the cell, often slightly geniculate at one or both ends or curved along the longitudinal axis, hyaline, biseriate in the ascus. Paraphyses filiform, 5-10 µm longer than asci at maturity, 1.5-2.0 µm wide, but narrowing slightly at the base and apex; sometimes branched near the base, hyaline, septate in the lower portion. Ectal excipulum of textura porrecta; cell lumen visible; cell walls faintly visible with phase contrast optics; cells mostly 7-15 x 3.0-4.5 µm, becoming larger and forming texture prismatica near the margin of old apothecia.

HOST - Found primarily on the fleshy portions of the fronds of tree ferns and other large members of the Cyatheaceae, also known from *Gleichenia*, and reported from bamboo (Dennis, 1960).

RANGE - Common in Venezuela and Colombia, known from Cuba, Ecuador, and Jamaica. Probably extensive throughout the higher elevations of its hosts' ranges in the New World Tropics, but not yet reported from the Old World Tropics.

ETYMOLOGY - *fimbriifer* = bearing a fringed border. From the Latin *fimbria*, a fringed border.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Dennis, Kew Bull. 9:310, fig. 20. 1950.

SPECIMENS EXAMINED - Cuba: Wright, 654, December, sometime between 1856 and 1866, no location given "on stems of ferns." Portions of this type material deposited in the Curtis Herbarium at (FH) and the Berkeley Herbarium at (K). Venezuela: Dumont - VE 2062, K.P. Dumont, J.H. Haines, G.J. Samuels, 13. VII. 1971, 19 km above Maracay on Maracay Choroní road, Parq. Nac. Henry Pittier, Edo Aragua (NYS) on rachis of unidentified tree fern. Dumont - VE 2117, 2129, 2138 (NYS) same data and location but on spiney fern rachis. Dumont - VE 2861, K.P. Dumont, G.J. Samuels and L. Borjas, 24. VII. 1971, ca 4 km inside San Javier del Valle resort, 7 km NE of Mérida, Edo Mérida, on fern rachis (NY); Dumont - VE 5021, K.P. Dumont, G.J. Samuels, G. Morillo and J. Farfan, 13. III. 1972, trail from Los Pocitos through La Roma to Río Grande Arriba, Edo Sucre, on fern rachis (NY). Jamaica: CUP-MJ 156, R.P. Korf et al., 9.I. 1971, along Lady's Mile Trail to just south of Woodcutter's Gap, vicinity of Newcastle, border of St. Andrew and Portland Parishes, on rachis of *Gleichenia* sp. (CUP); CUP-MJ 301, R.P. Korf et al., between Woodcutter's Gap and ruins of Major Wallin's House, vicinity of Newcastle, Portland Parish, on rachis of *Gleichenia* (CUP): CUP-MJ 341, R.P. Korf et al., 11.I. 1971, near Dick's Pond, west of Hardwar Gap, near Holywell Recreation Area, St. Andrew Parish, elev. 2800-3000 ft., on *Gleichenia* rhizome (CUP); CUP-MJ 584, R.P. Korf et al., 17.I. 1971, trail from Whitfield Hall to Portland Gap, to Blue Mt., border of St. Thomas and Portland Parishes, on rachis of *Cyathea* (CUP). Colombia: Dumont-CO 155, 192, 207, 221, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velásquez, 29.V. 1974, EL Bosque de Las Mercedes, Bojaca, Dpto. Cundinamarca, on rachis of tree fern, (NY); Dumont - CO 307, K.P. Dumont, J.H. Haines, and J.M. Idrobo, 1.VII. 1974, Alto de San Miquel, road between Sibate and Fusagasuga, Dpto. Cundinamarca, on rachis of fern (NYS); Dumont - CO 979, 980, 994, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velásquez, 10.VII. 1974, vicinity km 15 from Fomeque, road between Calera and Fomeque, Dpto. Cundinamarca, on rachis of Cyatheaceae (NYS); Dumont - CO 2737, 2748, 2752, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina, 15.I. 1976, ca 23 mi. from Altamira on the Altamira-Florencia Road, Dpto. Huila, elev. ca 7400 ft., on fern rachis (NY). Ecuador: Dumont - EC 1467, K.P. Dumont, S.E. Carpenter and P. Buriticá, 24.VII. 1975, ca 2 km from Puyo, on the Ambato-Puyo Road, Prov. Pastaza, elev. ca 4,000 ft., on fern rachis (NY).

D. fimbriifer is one of the earliest names applied to the tropical fern inhabiting Hyaloscyphaceae. It appears to be a part of a small complex of taxa which are indistinguishable macroscopically and in their excipular and hair characteristics, but differ in spore characters. As material from different geographical regions and different seasons is examined, the separation of those taxa as species becomes less clear. It is proposed here to treat these taxa as varieties of *D. fimbriifer*.

With a dissecting microscope or good field lens, *D. fimbriifer*, including all of its varieties, is distinguished by its long white to pale yellow hairs which point away from the substrate to partially obscure its cream-colored hymenium. *D. varians* differs in having shorter, buff-yellow hairs with lumps of amber to ruby-colored matter.

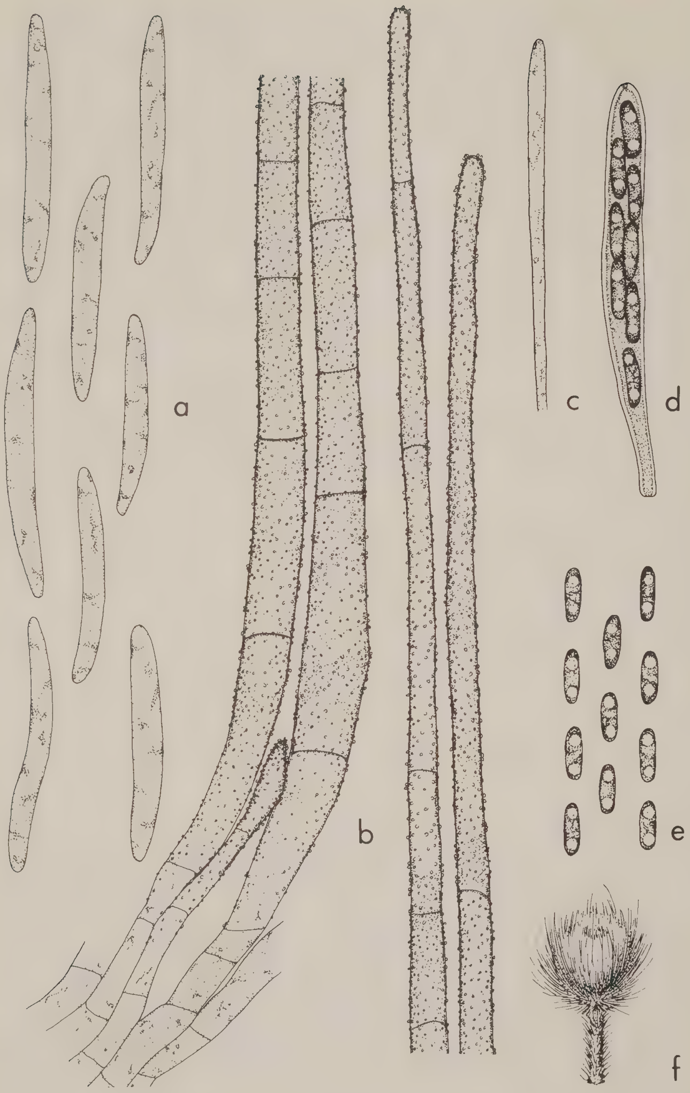

Fig. 3. *Dasyscyphus fimbriifer*, a. spores of var. *fimbriifer*, b-f. holotype of var. *singerianus*, b. hairs, c. paraphysis, d. ascus, e. spores, f. apothecium a-e, 1350X, f. much larger than natural size.

A number of collections from high elevations in Colombia and Venezuela have 0- to 1- septate spores 14-20 x 3-3.5 µm, long hyaline hairs characteristic of *D. fimbriifer* and short yellow hairs with colored matter at the tips characteristic of *D. varians*. Since the spore differences are small and placing too much emphasis on water soluable matter probably unwise, a new variety is unwarrented. These specimens are: Colombia, Dumont - CO 352B, K.P. Dumont, J.H. Haines and J.M. Idrobo, 1.VII. 1974, Quebrada Aquas Blancas, road between Sibate and Fusagasuga, Dpto. Cundinamarca, on petiole of tree fern (NYS); Dumont - CO 457, K.P Dumont, J.H. Haines and J.M. Idrobo, 2VII. 1979, Páramo de Choachí, road between Bogotá and Choachí, Dpto. Cundinamarca, on rachis of unidentified fern (NYS). Venezuela: Dumont - VE 2570, 2591, K.P. Dumont, J.H. Haines, G.J. Samuels, S. Silverborg, and L. Borjas, 20. VII. 1971, ca 63 km from Mérida, Univ. Los Andes Forest Reserve, La Carbonera, Edo. Mérida, on tree fern (NYS); Dumont - VE 2886, 2904. K.P. Dumont, G.J. Samuels and L. Borjas, 24.VII. 1971, ca 4 km inside San Javier del Valle resort, 7 km NE of Mérida, Edo. Mérida. on tree fern (NYS).

4. *Dasyscyphus fimbriifer* var. SINGERIANUS (Dennis) Haines, Comb. et stat. nov. Fig. 3, e-f

Basionym - *Dasyscyphus singerianus* Dennis, Kew Bull. 13: 465. 1958.

HOLOTYPE - R. Singer, B602, 28.I. 1956, Cataratas San Juan, Prov. Nor-Yungas, Dpto. LaPaz, Bolivia, altitude ca 2400 m, "on dead petioles and especially thorns of *Dicksonia* and other tree ferns" (K).

Apothecia, hairs and ectal exciple indistinguishable from the typical variety. Asci. 35-50 x 3.6-4.8 µm, pore plug visible with phase optics, blued with Melzer's solution, not subtended by a crozier. Spores 6-12 x 1.5-2.0 µm, non-septate, cylindrical, with rounded tips, not curved in the longitudinal axis, symmetry bipolar, usually with a large vacuole at each end. Paraphyses 1.8-2.0 µm at the widest point, which is 5-15 µm below the tip, exceeding the asci by 5-15 µm.

HOSTS - Usually on tree ferns and large members of the Cyatheaceae. One collection, EC - 1404, on a palm species is included here.

RANGE - Throughout the andean range from Venezuela to Bolivia and Jamaica. It is probably common wherever the hosts occur, and coincident with the range of the typical variety.

ETYMOLOGY - *singerianus* for the eminent mycologist Rolf Singer, the collector of the type specimen.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Dennis Kew Bull. 13: 466. 1958. Fig. 7.

SPECIMENS EXAMINED - Bolivia: (see holotype). Colombia: Dumont - CO 1087, K.P. Dumont, J.M. Idrobo and L.F. Velásquez, 13.VII. 1974, near km post 20 from Cali on road between Cali and Buenaventura, Dpto. Valle, on petiole of Cyatheaceae (NYS); Dumont - CO 2230, K.P. Dumont, P. Buriticá and J.L. Luteyn, 7.I. 1976, vicinity of km post 18 from Bogotá, on the Bogotá-Villavicencia Road via Cáqueza, Dpto. Cundinamarca, elev. ca 10,200 ft. on fern rachis (NYS); Dumont - CO 2693, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina, 15.I. 1976, ca 20 mi. from Altamira on the Altamira-Florencia Road, Dpto. Huila, elev. ca 6,500 ft. on large fern rachis (NY); Dumont - CO 2975, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina 18,I. 1976, ca 32 mi. from Florencia, on the Florencia-El Doncello Road, Intendencia Caqueta, elev. ca 4,800 ft., on small fern rachis (NY). Ecuador: Dumont - EC 1404, K.P. Dumont, S.E. Carpenter and P. Buriticá, 24.VII. 1975, ca 73 km from Ambato, on the Ambato-Puyo Road, border between Tungurahua and Pastaza Provinces, elev. ca 4,800 ft., on unidentified palm frond (NY). Jamaica: CUP-MJ-290, R.P. Korf, J.R. Dixon, K.P. Dumont, R.W. Erb, D.H. Pfister, D.R. Reynolds, A.Y. Rossman and G.W. Samuels, 11.I. 1971, on trail between Woodcutter's Gap and ruins of Major Wallin's House, vicinity of Newcastle, Portland Parish, on rachis of *Cyathea* sp. (CUP). Peru: Dumont - PE 409, K.P. Dumont, S.E. Carpenter, M.A. Sherwood & P. Buriticá, 2.VII. 1976, vicinity km post 450 from Lima on the Huanuco, elev. 8,500 ft., on fern rachis (NY). Venezuela: Dumont - VE 2123, VE 2142, K.P. Dumont, J.H. Haines and G.J. Samuels, 13.III. 1971, ca 19 km above Maracay, on Maracay-Choroní Rd., Parq. Nac. Henry Pittier, Edo. Aragua on rachis of tree fern (NYS); Dumont VE 3132, 26.VII. 1971, K.P. Dumont, G.J. Samuels and L. Borjas, ravine ca 76 km from Barrancas, on Mérida-Barinas Rd., Edo. Barinas, on large unidentified fern (NYS).

DISCUSSION - *Dasyscyphus singerianus* was originally described as having 1-septate spores, but on reexamination of the type specimen with phase contrast microscopy after mounted for 24 hrs. in 3% KOH to loosen and expand the cell wall material no septum was observed. Most spores, however, have a prominant refractive vacuole at each end which compresses the cell contents into the center which under low magnifications could be mistaken for a septum. Without the character of spore septation, it is only a matter of spore size which separates it from *D. fimbriifer*. Although the spore size difference is considerable, an intermediate series of collections has been examined. Colombia: Dumont - CO 350, K.P. Dumont, J.H. Haines and J.M. Idrobo, 1.VII. 1974, Quebrada Aguas Blancas, road between Sibate and Fusagasuga, Dpto. Cundinamarca (NYS); Dumont - CO 1481, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velásquez, 16.VII. 1974, Western slope of Cordillera Occidental, road between El Tambo and Veinte de Julio, Dpto. Cauca, on rachis of tree fern (NYS). Mexico: CUP-ME 244, K.P. Dumont, 15.VIII. 1967, 3-4 mi. N of junction to Simojoval, on road from Tuxtual Gutierrez to Villahermosa, Chiapas, on tree fern (? *Cyathea* sp.) (CUP), (NYS). Venezuela: Dumont - VE 2878, K.P. Dumont, G.J. Samuels and L. Borjas, 24.VII. 1971, ca 4 km inside San Javier del Valle resort, 7 km NE of Mérida, Edo. Mérida, on fern rachis (NY). These specimens have spores 9-12 µm long and usually contain more than two refractive vacuoles. The following collections have spores ranging from 12-16 µm in length and complete the connection between *D. fimbriifer* var. *fimbriifer* and *D. fimbriifer* var. *singerianus:* Dumont - CO 2708, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina 15.I. 1976, ca 20 mi. from Altamira on the Altamira-Florencia Road, Dpto. Huila, elev. ca 6,500 ft., on fern rachis (NYS). Dumont - CO 2749, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina, 15.I. 1976, ca 23 mi. from Altamira on the Altamira-Florencia Road, Dpto. Huila, elev. ca 7,400 ft. on fern rachis (NY).

5. *Dasyscyphus BREVISPORUS* (Otani) Haines, comb. et stat. nov. Fig. 4.

≡*Dasyscyphus fimbriifer* var. *brevisporus* Otani, (as *D. fimbriiferus* var. *brevisporus*). Reports of the Cryptogams in Papua, New Guinea (Tokyo), p. 31, 1975.

HOLOTYPE - Y. Otani, No. 10659, TNS-F-50005, 18.I. 1974, Mt. Albert Edward, Woitape, Central District, New Guinea, on fern rachis (TNS).

Apothecia solitary or scattered on the substrate, goblet shaped, to 1.5 mm in diam., stipitate, stip to 0.8 mm long, excipulum light buff, completely covered with very long, upward oriented, stiff, bright white, dry-appearing hairs to 0.6 mm long; no conspicuous adhering particles visible under a dissecting microscope; disc buff-yellow, completely obscured by the hairs when dry; no color change when placed in 3% KOH. Hairs to 600 x 3.0-3.5 µm, tapered to 1.8-2.2 µm at the apices, septate, hyaline, thin-walled toward the apex, up to 0.9 µm thick near the base, covered with small, discrete, rod-like particles to 1.0 µm long, slightly longer than broad, appearing capitate in optical section, perpendicular to the hair wall in longer hairs, appearing slightly slanted toward the apex in shorter hairs; a few long hairs bearing a small amount of hyaline resinous matter near their tips and visible only with a compound microscope; a few short, rough, thin-walled, flexuous hairs intermixed with the longer ones. Ectal exciple composed of distinct, thin-walled, hyaline textura prismatica, the individual cells 15-30 x 4-8 µm, becoming smaller toward the stipe. Asci 60-71 x 5.5-7.0 µm, 8-spored, cylindrical with a hemispherical apex and tapered base, j+ pore clearly visible with phase contrast optics, appearing as a tapered cylinder about 1.0 µm in diam. in optical cross section of stained material. Spores 10-13 x 1.8-2.7 µm, non-septate, hyaline, smooth, nearly cylindrical, slightly curved, with rounded tips, usually without conspicuous vacuoles or other inclusions. Paraphyses cylindrical or very slightly enlarged in the upper third, 1.8-2.5 µm in diam. at the widest point, slightly tapered above to a blunt apex, hyaline, smooth, without adhering particles, septate in the lower two-thirds only, exceeding the asci by up to 10 µm in the hymenium.

HOST - On pinnae and rachises of large ferns. The portion of the type examined by the author was a portion of fern rachis about 3.0 mm in diam.

RANGE - Know only from type collection from New Guinea.

ETYMOLOGY - *Brevisporus* - short-spored, referring to its having shorter spores than the type variety of *D. fimbriifer*.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Otani, Yoshio. Reports on the Cryptogams in Papua New Guinea published by the Party 1973-74, of "The Botanical Expedition to Papua New Guinea," The National Science Museum, Tokyo; fig. 15 f-j, Pl. 2H, p. 33, March, 1975.

SPECIMENS EXAMINED - A portion of the type was examined by the author (see holotype). There is a discrepancy in the locality information between the description and the packet for Otani No. 10659. The type packet gives the location as "Mt. Albert Edward" and the description as "Keglsugl." No attempt was made to resolve the difference.

DISCUSSION - This taxon is related to *D. fimbriifer* as concluded by Otani (1975). The granulation of the hairs, the substrate, the characters of the excipulum asci and paraphyses are similar to *D. fimbriifer* var. *fimbriifer*, and the spore size range is small enough to be included in *D. fimbriifer* var. *singerianus*. However, the very long hairs, robust apothecia, the different overall appearance and range are sufficient to allow it to stand as a separate species.

6. *Dasyscyphus varians* Rehm, Hedwigia 39:94. 1900 var. *Varians*. Fig. 5, a-e.

=*Lachnum gleicheniae* Cash, Mycologia 30:105. 1938.
  ≡*Lachnella gleicheniae* (Cash) Seaver, N. Amer. Cup-fungi (inoperculates) p. 266. 1951.
=*Dasyscyphus flavidulus* Rehm, Ann. Mycol. 7:542. 1909.

Isotype - E. Ule #758. Brasil, holotype in herb. Rehm (S) and lectotype in herb. Sydow (S).

Apothecia scattered on substrate, often spreading over large areas, goblet-shaped or funnel-shaped, to 0.6 mm in diam. and to 0.8 mm high, stipitate, pale buff, completely covered with short, pale buff to lemon-yellow hairs with conspicuous lumps of amorphous, water-soluable matter at the tips; lumps amber to dark ruby red, up to 0.1 mm in diam., dissolving but not changing color with 3% KOH; disc cream to ochre, usually obscured by marginal hairs when dry and exposed in mature apothecia when moist.

Hairs cylindrical to 100 µm long with a slightly tapered base and a hemispherical apex, generally 40-70 x 2.8-5.0 µm, thin-walled, pale straw-yellow with transmitted light, septate, roughened with hyaline, rod-shaped granules similar to those of *D. fimbriifer* and which appear to be slightly inclined towards the apex in some hairs. Ectal excipulum composed of short-celled, thin-to thick-walled, hyaline textura prismatica becoming textura angularis in some portions of the cup. Asci 40-52 x 3.8-5.1 µm, 8-spored, cylindrical with a tapered base and hemispherical apex, with a small but distinct J+ pore plug visible as a tapered cylinder in optical cross-section, croziers not observed at the base. Spores 6-11 x 1.5-2.2 µm, eliptical, tips rounded, slightly more tapered in the basal portion, hyaline, smooth, often with 2 conspicuous refractive inclusions, slightly curved along the longitudinal axis. Paraphyses hyaline, narrowly lanceolate or cylindrical with a tapered apex, septate only in the lower portion, 1.5-2.6 µm at the widest point, exceeding the asci by 1.0 µm in the hymenial arrangement.

HOSTS - On rachises of members of the Cyatheaceae, Gleicheniaceae and Dicksoniaceae including *Cyathea dealbata, Gleicheinia pectinata* and *Dicksonia squarrosa.* Also known from *Papuapteris linearis.*

RANGE - Found in northern and western South America, the Caribbean, Hawaii, New Guinea and New Zealand. It is probably found throughout the upper elevations of the range of the larger Cyatheaceae and otherlarge tropical ferns. It is not yet known from the African continent.

ETYMOLOGY - Varians = varying. Probably referring to the apparent color changes explained in the discussion.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Dennis Kew Bull. 9: 312. Fig. 22; Otani, Reports on the Cryptogams in Papua New Guinea p. 29. Fig. 14, a-d; Cash, Mycologia 30:99. Fig. 2 (as *Lachnum gleicheniae*); Dennis, Kew Bull. 9:311 (as *Dasyscypha flavidula*).

SPECIMENS EXAMINED - Colombia: Dumont - CO 158, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velásquez, 29. VI. 1974, El Bosque de Las Mercedes, Bojaca, Dpto. Cundinamarca, on fern rachis (NYS); Dumont - CO 308, K.P. Dumont, J.H. Haines and J.M. Idrobo, 1.VII. 1974, Alto de

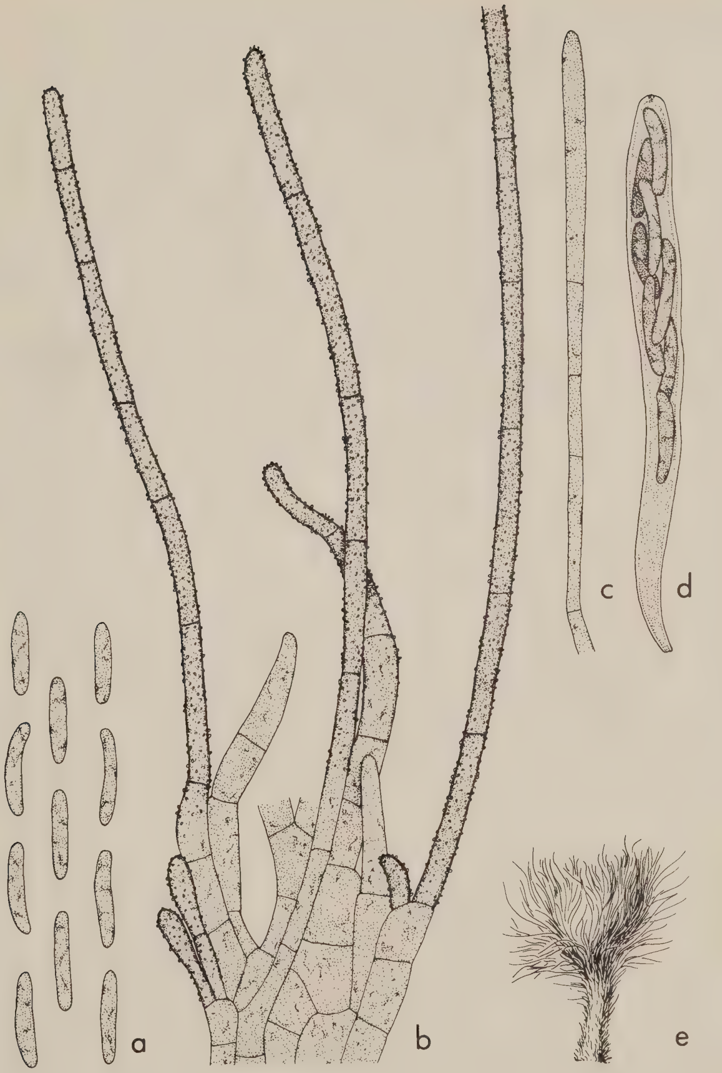

Fig. 4. *Dasyscyphus brevisporus*, type specimen, a. spores, b. ectal excipulum with hairs, c. paraphysis, d. ascus, e. apothecium. a-d. 1350X, e. much larger than natural size.

San Miguel, road between Sibate and Fusagasuga, Dpto. Cundinamarca, on fern petiole (NYS); Dumont - CO 358, K.P. Dumont, J.H. Haines and J.M. Idrobo, 1.VII. 1974, Quebrada Aguas Blancas, road between Sibate and Fusagasuga, Dpto. Cundinamarca, on fern rachis (NY); Dumont - CO 554, K.P. Dumont, J.H. Haines, L.F. Velásquez and R. Fonnegra, 5.VII. 1974, Buenos Aires, Providencia, Anorí, Río Anori, Dpto. Antioquia. on tree fern petiole (NYS); Dumont - CO 870, K.P. Dumont, J.H. Haines, L.F. Velásquez and R. Fonnegra, 6.VII. 1974, Popales, Providencca, Anori, above Rio La Tirana, Dpto. Autioquia, on tree fern rachis (NYS); Dumont - CO 1184, K.P. Dumont, J.M. Idrobo and L.F. Velásquez, 13.VII. 1974, vicinity km 20 from Cali, road between Cali and Buenaventura, Dpto. Valle, on petiole of Cyatheaceae (NYS); Dumont - CO 1486, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velasquez, 16.VII. 1974, Western slope of Cordillera Occidental, road between El Tambo and Viente de Julio, Dpto. Cauca, on rachis of tree fern (NYS); Dumont - CO 2297, K.P. Dumont, P. Buriticá and J.L. Luteyn, 7.I. 1976, ca 14 mi. from Villavicencio on the Villavicencio-San Martin Rod., Dpto. Huila elev. ca 2,600 ft., on fern rachis (NY); Dumont - CO 2887, 2925, 2929, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.H. Molina, 17.I. 1976, a 13 mi. from Florencia on the Florencia-El Doncello Road, Intendencia Caquetá. elev. ca 1,200 ft. on fern frond (NY). Ecuador: Dumont - EC 340, K.P. Dumont, S.E. Carpenter and P. Buriticá, 17.VII. 1975, ca 75 km SW of Chillogallo, on the old road from Quito to Santo Domingo, Prov. Pichincha. elev. ca 5,600 ft., on fern rachis (NY); Dumont - EC 1371, 1395, 1400, K.P. Dumont, S.E. Carpenter and P. Buriticá, 24.VII. 1975, ca 73 km from Ambato, on the Ambato-Puyo Road, border between Tungurahua and Pastaza Provinces, elev. ca 4,800 ft., on fern rachis (NY); Dumont - EC 1797, 1801, K.P. Dumont, S.E. Carpter and P. Buriticá, 31.VII. 1975. ca 21 km from Zanora, on the Zamora-Yanaza Road, Prov. Zamora, elev. ca 3,000 ft., on fern rachis (NY); Dumont - EC 1896, 1910, 1913, K.P. Dumont, S.E. Carpenter and P. Buriticá, 1.VIII. 1975, ca 12 km from Zamora, on the Zamora-Loja Road, Prov. Zamora, elev. ca 5,000 ft., on fern rachis (NY); Dumont - EC 1927, 1935, K.P. Dumont, S.E. Carpenter and P. Buriticá, 1.VIII. 1975, ca 22 km from Zamora, on the Zamora-Loja Road, Prov. Zamora, elev. ca 5,800 ft., on fern rachis (NY); Dumont - EC 2001, 2024, K.P. Dumont, S.E. Carpenter and P. Buriticá, 3.VIII. 1975, ca 5 km from Limón (General Plaza Gutierez), on the Limón-Mendez Road, Prov. Morona

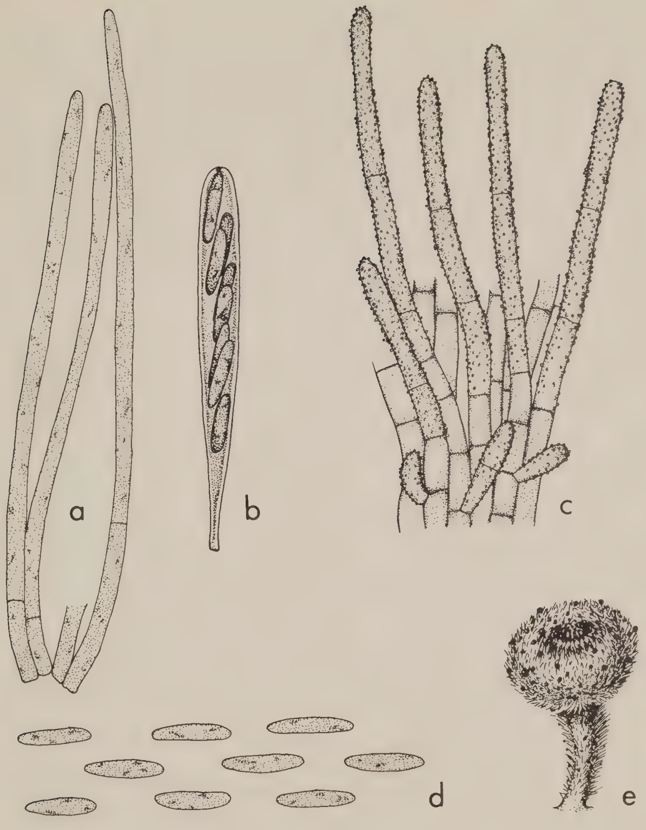

Fig. 5. *Dasyscyphus varians*. From VE 2878, a. paraphyses, b. ascus, c. exciple with hairs, d. spores, e. apothecium, a-d. 1370X, e. much larger than natural size.

Santiago, elev. ca 4,000 ft., on tree fern petiole (NY). Hawaii: Otto Degener, No. 2810, Otto Degener and Henry Wiebke, 12.IV. 1928, South of Hanaliioliio, Molokai, T.H. "on stipes of endemic *Dicranopteris*" as holotype of *Lachnum gleicheniae* Cash (BPI); C.L. Shear and N.E. Stevens 580, 28.XII. 1927, Olinda Pipe Line, Maui, on tree fern rachis, as *Lachnum gleicheiae* Cash (BPI); C.L. Shear and N.E. Stevens, 582, 17.II. 1928, above Waimea, Oahu, on rachis of *Gleichenia* sp. as *Lachnum gleicheniae* Cash (BPI). Jamaica: R.P. Korf et al., CUP-MJ 110, 8.I. 1971. Traveller's rest. Silver Hill Gap, on the border of Portland and St. Andrew Parish, elev. 3,000-3,250 ft. on fern rachis (CUP). Mexico: CUP, ME 244, K.P. Dumont, 15. VIII. 1967, 3-4 mi. N of Junction to Simojovel, on road from Tuxtula Gutierrez and Villahermosa, Chiapas, on tree fern (CUP). New Zealand: S.J. Hughes #1328 (DAOM 162333) 4.IX. 1963, Kauaeranga Valley, Thames, Auckland Dist., on rachis of *Dicksonia squarrosa* (DAOM); G.J. Samuels, PDD 31947, 7.VIII. 1973, Walker's Bush Track, Waitake Ranges, Waitemata County, Auckland, on rachis of *Cyathea dealbata* (PDD). Panama: Dumont - PA 1578, K.P. Dumont, S.E. Carpenter and S.A. Mori, 30 VI. 1975, Vicinity Altos de Pacora, 26-31 km N of Pan American Highway, on old road to Mandinga, Prov. Panama, elev. ca 2,100-2,200 ft. on rachis of tree fern (NY); Puerto Rico: F.J. Seaver and C.E. Chardon #546 (The New York Botanical Garden West Indian Exploration #1811) 1923, El Yunque, as *Dasyscypha flavidula?* on fern rachis (NY). Venezuela: Dumont - VE 1245, 1257, 1286, K.P. Dumont, J.H. Haines and G.J. Samuels 4.VII. 1971, 2-3 km along trail behind hotel, up Mt. Guacamaya, Rancho Grande, Parq. Nac. Henry Pittier, Edo. Aragua, on rachis of tree fern (NYS); Dumont - VE 1524, 1529, K.P. Dumont, J.H. Haines, G.J. Samuels and G.S. Bunting. In mountains N of Nirgua, Edo. Yuracuy, on rachis of large fern (NYS); Dumont - VE 2203, K.P. Dumont, J.H. Haines and G.J. Samuels, 14.VII. 1971. ca 7 km from Colonia Tovar, on Colonia Tovar-La Victoria Road, Edo Aragua, on fern rachis (NYS); Dumont - VE 2878, K.P. Dumont, G.J. Samuels and L. Borjas, 24.VII. 1971, ca 4 km inside San Javier del Valle resort, 7 km NE of Mérida, Edo. Mérida, on fern rachis (NY).

DISCUSSION - *D. varians* var. *varians* is the most common and widespread discomycete inhabiting the decaying remains of tropical ferns. It is related to *D. fimbriifer* and *D. brevisporus* in the slightly elongated hair granulations which often appear to be very slightly inclined toward the hair tips and in the exciple of rather distinct textura prismatica. It is distinguished from all other taxa of Hyaloscyphaceae by the combination of hair and spore size and the presence of yellow to dark red pigments on the hairs.

The aspect of this taxon which has caused confusion in its identification is the pigmentation associated with the hairs. One of the distinctions drawn here by the author between *D. fimbriifer* and *D. varians* is that the former has hyaline hairs and the latter a pale straw pigment located in the walls of the hair. In addition, a water-soluable lemon-yellow pigment is located on or in hairs of young apothecia which progressively darkens and concentrates into large lumps of matter 20-50 μm. These lumps are light amber on lemon-yellow hairs at first and darken to deep garnet red on light buff-white hairs with age. The pigment may be absent altogether in water soaked specimens. These color shifts can cause an array of differently colored apothecia growing together on the same piece of substrate. A second confusing aspect of *D. varians* is the continuum of spore sizes. *D. varians* var. *varians* and *D. varians* var. *pteridophyllus* represent modes in the spore size continuum and intermediate spore sizes can be found.

It is possible that *D. varians* published by Rehm in 1900 is a later synonym of *D. tubiformis* P. Hennings & E. Nyman, Monsunia 1:32, 1899 but a number of inquiries did not locate the Hennings type, so for the time being, *D. tubiformis* remains unexamined. *D. cyatheicola* P. Hennings, Hedwigia 41:25. 1902 is perhaps also a later synonym, but no type was located for it either.

7. *Dasyscyphus varians* var. PTERIDOPYLLUS (Rodw.) Haines, comb. et stat. nov.
   Basionym - *Dasyscypha pteriodophylla* Rodway, Pap. & Proc. Roy. Soc. Tasmania 1920:158, 1921.

TYPE COLLECTION - L. Rodway, October 1920, National Park (Tasmanian?), on stipe of dead *Dicksonia antarctica*. (HO). No specimen is mentioned in the place of original publication, but this specimen is clearly marked "type."

Apothecia, hairs, asci, paraphyses, excipulum and disc indistinguishable from those of the typical variety of *D. varians*. Spores 11-17 x 1.0-1.9 μm, straight, with bipolar symmetry, fusiform, tapered to sharply acute apices, rarely 1-septate, sometimes with 2 or 4 refractive vacuoles.

HOSTS - Known from species of Cyatheaceae, *Cyathea dealbata*, Dicksoniaceae, *Dicksonia antarctica* and

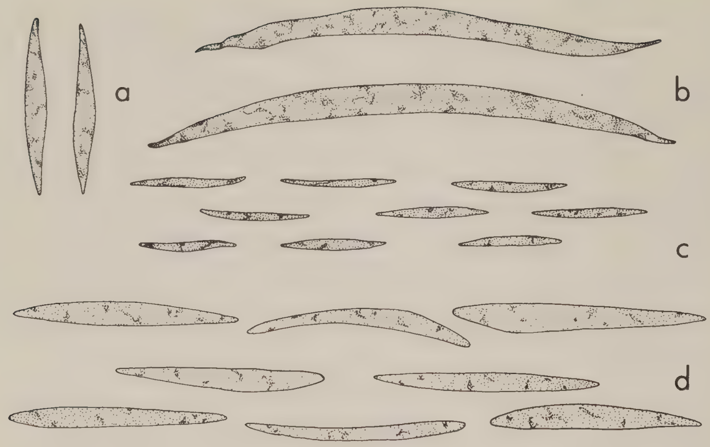

Fig. 6. Spores, a. from lectotype of *Dasyscypha javanica*, b. from Penzig and Saccardo #26 *D. oncospermatis* var. *macrospora*, c. from holotype of *D. varians* var. *pteridophyllus*, d. from holotype of *D. oncospermatis* var. *oncospermatis*, all 1370X.

Gleicheniaceae, *Gleichenia* sp.

RANGE - Colombia, Jamaica, Mexico, Panama, Peru, Puerto Rico, New Guinea, New Zealand, Tasmania and Venezuela. Perhaps throughout the range of large tropical ferns and coincident with the range of the type variety.

ETYMOLOGY - Pteridophyllus = fern leaves.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Dennis, Kew Bull. 13: 329. 1958. Fig. 8; Otani, Reports on the Cryptogams of Papua, New Guinea 1975:27, Fig. 13 e-i. 1975.

SPECIMENS EXAMINED - Colombia: Dumont - CO 393, K.P. Dumont, J.H. Haines and J.M. Idrobo, 1.VII. 1974, Quebrada Aguas Blancas, road between Sibate and Fusagasuga, Dpto. Cundinamarca on fern petiole (NYS); Dumont - CO 1514, K.P. Dumont, J.H. Haines, J.M. Idrobo and L.F. Velásquez, 16.VII. 1974, Western slope of Cordillera Occidental road between El Tambo and viente de Julio, Dpto. Cauca, on rachis of tree fern (NYS); Dumont - CO 2746, 2751, K.P. Dumont, P. Buriticá, J.L. Luteyn and L.A. Molina, 15. I. 1976, ca 23 mi. from Altamira on the Altamira-Florencia Road, Dpto. Huila. elev. ca 7,400 ft., on fern rachis (NY). Jamaica: CUP-MJ 280, R.P. Korf et al., 11.I. 1971, on trail between Woodcutter's Gap and ruins of Major Wallin's House, vicinity of Newcastle, Portland Parish, on rachis of *Gleichenia* (CUP); CUP-MJ 336, R.P. Korf et al., 11.I. 1971, Near Dick's Pond, west of Hardwar Gap, near Holywell Recreation Area, St. Andrew Parish, elev. 2,800-3,000 ft., on rachis of *Gleichenia* (CUP). Mexico: CUP-ME 319, K.P. Dumont, 25.VIII. 1967, km 141 on road between Oaxaca and Valle National, Oaxaca, on tree fern, *Cyathea* sp.? (CUP). Panama: Dumont - PA 263, K.P. Dumont, S.E. & S.M. Carpenter and S.A. Mori, 14.VI. 1975, from base of Cerro Pilón to summit, 5 km NE of El Valle, Prov. Cocles elev. ca 2,200-3,000 ft., on tree fern petiole (NY); Dumont - PA 337, K.P. Dumont, S.E. & S.M. Carpenter and S.A. Mori, 14.VI. 1975, vicinity of La Mesa, 2.5 km N of El Valle, Prov. Cocle, elev. ca 2,100 ft., on fern rachis (NY); Dumont - PA 1571, K.P. Dumont, S.E. Carpenter and S.A. Mori, 30.VI. 1975, vicinity Altos de Pecora, 26-31 km N of Pan American Highway, on old road to Mandinga, Prov. Panama, elev. ca 2,100-3,000 ft., on petiole of fern (NY). Peru: Dumont - PE 412, 444, K.P. Dumont, S.E. Carpenter, M.A. Sherwood and P. Buriticá, 2.VII. 1976, vicinity km post 450, from Lima on the Huanuco-Tingo María Rd., Dpto. Huanuco elev. 8,500 ft., on fern rachis (NY). Dumont - PE 1725, K.P. Dumont, S.E. Carpenter, M.A. Sherwood & P. Buriticá, 19.VII. 1976, along the Cuzco-Pilcopata-Paucartambo Rd., at a point ca 135 km from the intersection of the Cuzco-Puno Rd., Dpto. Cuzco., on fern rachis (NY). Puerto Rico: Haines - PR 11, 15, J.H. Haines, R.P. Korf, et al., 5.VI. 1970, El Toro Trail, El Yunque Luquillo Experimental Forest, elev. ca 700 m, on *Alsophylla* rachis (NYS); Haines - PR 14, J.H. Haines, R.P. Korf, et al., 8.VII. 1970, Rt. 191 & 930, El Yungue, Luquillo Experimental Forest, elev. 700 m, on *Gleichenica pectinata* rachis (NYS); Haines - PR 17, J.H. Haines, R.P. Korf, et al., 8.VI. 1970, Rt. 930, El Yunque, Luquillo Experimental Forest, elev. ca 675 m, on rachis of *Cyathea dryopteriodes* (NYS); Haines PR - 19, J.H. Haines, R.P. Korf, et al., 8.VI. 1970, Rts. 191 & 930, El Yunque, Luquillo Experimental Forest, elev. ca 675 m, on rachis of *Alsophila borinquena* (NYS). New Zealand: PDD 19348 (=DAOM 75775), J.M. Dingley, 28.VIII. 1954, Whitianga, Auckland Prov., on *Cyathea medullaris* Swartz, (DAOM), PDD 31944 (=JHH 2808), G.J. Samuels, 8.VII. 1973, Walker's

Bush Track, Waitakere Ranges, Waitemata County, Auckland Prov., on rachis of *Cyathea dealbata* (NYS, PDD). Tasmania: (see type) Venezuela: Dumont - VE 2206, K.P. Dumont, J.H. Haines and G.J. Samuels, 14.VII. 1971, ca 7 km from Colonia Tovar, on Colonia Tovar-La Victoria road, Edo. Aragua, on fern rachis (NYS); Dumont - VE 2568, K.P. Dumont, J.H. Haines, G.J. Samuels, S. Silverborg and L. Borjas, 20.VII. 1971, ca 63 km W of Mérida, Univ. Los Andes Forest Reserve, La carbonera, Edo. Mérida, on rachis of tree fern (NYS).

DISCUSSION - Since a large number of collections were examined, intergradations were found between those that match the type of *D. pteridophyllus* and those fitting the description of *D. varians*. The two taxa are not retained as separate species and *D. pteridophyllus*, the more recent of the two names is reduced to a variety. There are several names described earlier than *D. pteridophyllus* which if types could be located may prove to be the same species. These are *D. tubiformis* (see under *D. varians*), *D. javanica* var. *citrinula* Penz. & Sacc. 1901, and *D. merrillii* Sydow 1913.

8. *Dasyscyphus oncospermatis* (Berk. & Br.) var. *oncospermatis* Sacc., Syll., Fung. 8:465. 1889. (as *Dasyscypha oncospermatis*)

≡*Peziza oncospermatis* Berk. & Br., J. Linn. Soc. Bot. 14:105. 1975.
≡*Aranea oncospermatis* (Berk. & Br.)Petch, Ann. Roy. Bot. Gard. Peradiniya 6:164. 1917.
≡*Atractobolus oncospermatis* (Berk. & Br.) O. Kuntze, Revis. Gen. Pl. 3(2):446. 1898.
=*Dasyscypha lanariceps* (Cke. & Phill.) Sacc., Syll. Fung. 8:465, 1889.
≡*Peziza lanariceps* Cke. & Phill., Grevillea 8:62. 1879.
≡*Atractobolus lanariceps* (Cke. & Phill.) O. Kuntze. Revis. Gen. Pl. 3:446. 1898.
=*Dasyscypha javanica* Penz. & Sacc., Malpighia 15:209. 1901. (not to be confused with *Arenaea javanica* Penz. & Sacc., *Erinella javanica* Henn. & Nym. nor *Erinella javensis* Höhn.)
=*Dasyscypha cyatheae* Rehm, Leafl. Philipp. Bot. 6:2280. 1914.

HOLOTYPE - Thwaits, Ceylon #435, Habgalla (sic), Dec. 1867, ex herb C.E. Broome (K).

Apothecia scattered on substrate, often spreading over large areas, with convoluted margins or branched stipes with as many as a dozen cups on a single stipe, up to 1.0 mm across in multiple structures, single apothecia smaller, infundibulaform covered with short, straight, buff-yellow hairs capped with lumps of light red to deep garnet-colored resinous-appearing matter; disc concealed by hairs when dried. Hairs cylindrical with hemispherical tips and slightly tapered bases, straight, septate, straw-colored with transmitted light, 3.0-4.6 by up to 100 µm long, generally 40-70 µm, with walls up to 0.7 µm thick, roughened with granules as in *D. varians*. Ectal excipulum composed of small-celled, hyaline to buff textura prismatica. Asci 52-80 x 4.0-7.0 µm, 8-spored, cylindrical with a tapered base and hemispherical apex with a distinct J+ pore plug visible as a tapered cylinder in optical cross section. Spores (17-) 18-28(-31) x (1.5-) 2.0-3.0 (-3.5) µm, straight, hyaline, non-septate or rarely 1- or 3-septate, fusiform with distinctly pointed tips, usually with refractive vacuoles ranging from very tiny inclusions to almost filling the spore. Paraphyses filiform, very slightly tapered at the immediate apex, hyaline, 1.2-1.7 µm wide, slightly longer than the asci, septate and often branched in the lower portion.

HOST - Known from large ferns of the Cyatheaceae; *Hemitilia, Alsophila, Cyathea*. It is also known from *Rhipogonum* (Liliaceae), but the report from *Oncosperma* is questionable.

RANGE - Known from Ceylon, Australia, Java and the Philippines.

ETYMOLOGY - *Oncospermatis* from *Oncosperma*, a genus of Palms.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Penzig & Saccardo, Icones Fungorum Javanicorum, Tab. L, fig. 3 as *D. javanica*; Dennis, Kew Bull. 17:356, fig. 50.

SPECIMENS EXAMINED - Ceylon: (type; see above for information) Sydow, Fungi exotici exsiccati #227, Jan. 1914, Hatgala, Ceylon, T. Petch, on rachis of *Hemitiliae walkerae* (DAOM) (CUP). Australia: Berggren #363, Melbourne 1974-1975, on *Rhipogonum*, (type of *Peziza lanariceps*) ex herb. CKE (K). Java: Penzig #20, XI. 1897, Tjibodas, on rachis of *Alsophia,* as *D. javanica* ex herb. Saccardo (PAD). Philippine Islands: C.F. Baker #2727, 31.I. 1914, Mt. Makiling, Los Baños, on rachis of *Cyathea candata,* holotype of *D. cyatheae*, ex herb. Rehm (S); C.F. Baker, Fungi Malayana #23, I. 1914, Mt. Makiling, ex herb. Sydow (S), (NY).

DISCUSSION - *Dasyscyphus oncospermatis* is closely related to *D. varians* in having similar hairs, colored exudates and exciple. It differs by having longer spores and asci and by having a branched stipe in some collections. It has not been resolved whether this species occurs in South America. Although some collections have been made there which have spore sizes in the range of *D. oncospermatis*, the branched character of the stipe has not been found.

There is some confusion over host identification which results in a fern-inhabiting species having the specific epithet "*oncospermatis*" which is derived from the palm *Oncosperma*. The type specimen does appear to be on a segment of fern stipe as was stated by Petch (Dennis, 1963).

Even though *Dasyscyphus javanica* is reduced to synonomy under *D. oncospermatis,* it is necessary to choose a lectotype for it from among the three collections mentioned by Penzig & Saccardo in the original description. I hereby choose collection #20 from PAD as lectotype. It is a small but completely recognizable collection.

9. *Dasyscyphus oncospermatis* var. *MACROSPORUS* (Penz. & Sacc.) Haines, comb. et stat. nov.

≡*Arenaea macrospora* Penz. & Sacc. Malpighia 15:211. 1901.

TYPE - According to the original description the type (implicit holotype because it is the only specimen mentioned) is "in petiolis putridis Palmarum, Tjibodas, 8.II. 1897 (16)."

Apothecia, hairs and excipulum indistinguishable from the type variety of *D. oncospermatis*. Asci cylindrical, or clavate, 8-spored, 90-110 x 12-14 μm, thick-walled walls up to 1.5 μm thick, definite large J+ pore plug. Spores 36-67 x 2.5-3.5 μm, fusiform, with bipolar symetry and a very fine, hair-like appendage 1-2.5 μm long at each end, curved along the longitudinal axis, non-septate, usually without refractive contents. Paraphyses filiform 1.1-1.5 μm wide, sometimes enlarged slightly at the apex, septate, without pigments or conspicuous inclusions.

HOST - Although the type description states that *Dasyscyphus oncospermatis* was collected on palm petioles, collection #20 from Saccardo's herbarium in Padua which was collected at the same place and date is on remnants of a fern petiole as the piece of substrate in the packet has fern pinnae attached to it.

RANGE - Known only from two collections made in Java.

PREVIOUSLY PUBLISHED ILLUSTRATIONS - Penzig & Saccardo, Icones Fungorum Javanicorum Tab. LI, fig. 4. 1904.

SPECIMENS EXAMINED - 8.II (no year given) Tjibodas Java, #23 ex herb. Saccardo (PAD). This is the only collection under this name at Padua. It bears the same data as the type description but a different collection number.

DISCUSSION - Since collection #23 from Saccardo's herbarium fits the type description and illustration well, it will be included here as representative of this taxon. There are only spore size and shape and minor differences in paraphysis shape to separate it from *D. oncospermatis* var. *oncospermatis*.

ACKNOWLEDGMENTS

I am deeply indebted to Dr. Kent P. Dumont, his National Science Foundation grant #GB2893, The Flora Neotropica Project, the New York State Museum/Science Service, Dr. Richard P. Korf and the many kind people of Venezuela, Colombia and Puerto Rico who made it possible for me to collect and examine tropical discomycetes, to Dr. Korf for reading and making constructive comments on the manuscript and to the curators and directors of the following herbaria who searched for and made available

type specimens: K, S, B, C, TNS, BPI, CUP, MICH, FH, TAA, HO, DAOM, NY, PAD.

I particularly wish to thank Dr. Danial E. Stuntz who had nothing to do with this paper, but had everything to do with instilling in me an interest in mycology which is the reason this was written.

All of the "Dumont-" specimens at NYS are duplicates of collections deposited at NY and a major herbarium in the country of origin.

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PARMELIELLA DUPLOMARGINATA, A NEW LICHEN FROM NEW ZEALAND

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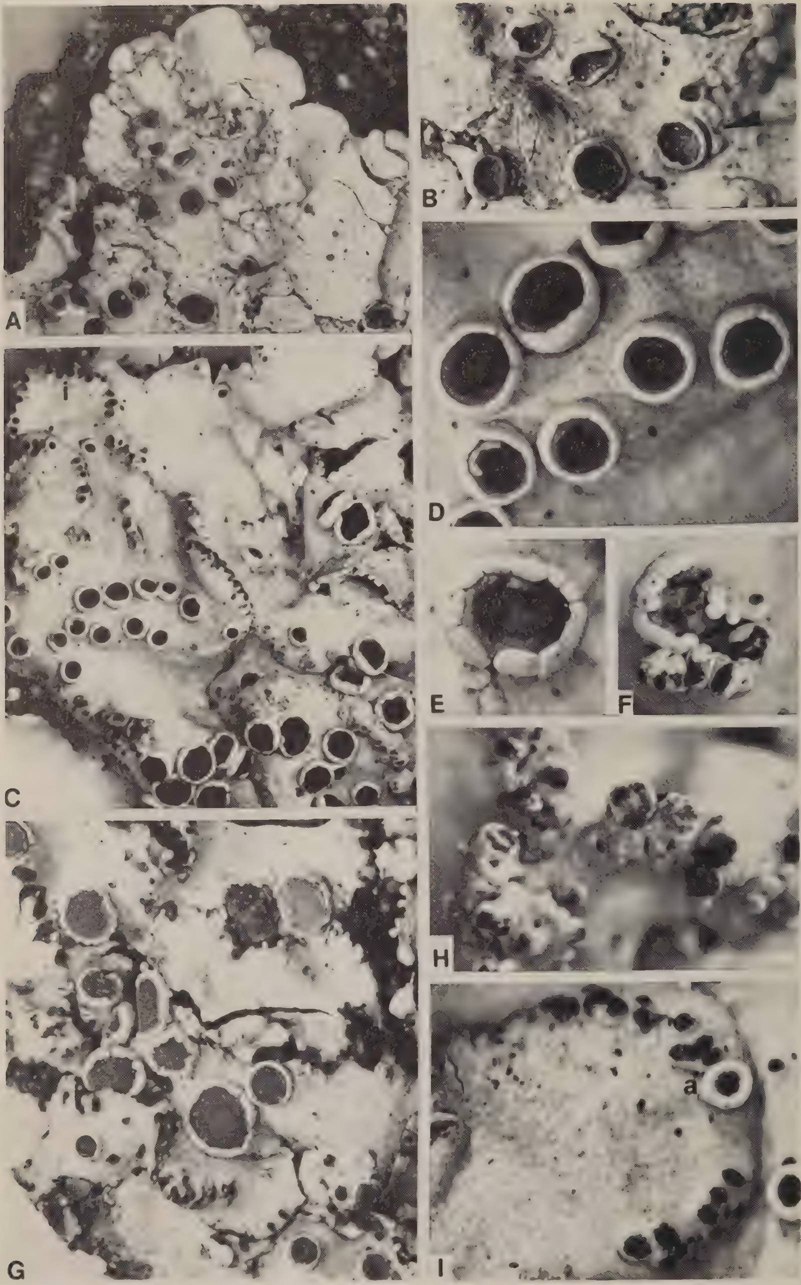
SUMMARY

The new species *Parmeliella duplomarginata* P.James et Henssen is characterized by the formation of a double apothecial margin comprising both an excipulum proprium and a margo thallinus, by the periclinal arrangement of the thallus hyphae, and by having a species of *Scytonema* as its phycobiont. The close relationship to *Parmeliella gayana* is discussed.

INTRODUCTION

In 1969 one of us (A.H.) described an unusual ontogenetic development of the apothecia of an undescribed *Parmeliella* species from New Zealand (Henssen 1969, also see Henssen & Jahns 1973, as "*Parmeliella coronata*"). This species is characterized by the formation of a conspicuous double apothecial margin comprising a well developed excipulum proprium surrounded by an equally distinct margo thallinus. Although a secondary development of a thalline margin is a common feature of the Pannariaceae (Henssen 1969, Keuck 1977) its form is unusual in the new species as the margo thallinus is developed some distance from the differentiating excipulum proprium (Fig. 2, 3A,B).

Subsequently we have been able to examine more collections of our new species finding that the margo thallinus may occasionally be only partly developed or sometimes ab-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sent (Fig. 1 A,B).

The specific ephithet *duplomarginata* has been selected for the new species as it draws attention to the unusual form of the apothecial margin.

In morphology and anatomy *P.duplomarginata* closely resembles *P.gayana*. The thallus anatomy of both species is superficially like that of certain species of *Coccocarpia* but a comparative study of the ascocarp ontogeny of this family with that of the Pannariaceae indicates that such similarities that exist can only be considered as evidence of convergence (cf. also Keuck 1977).

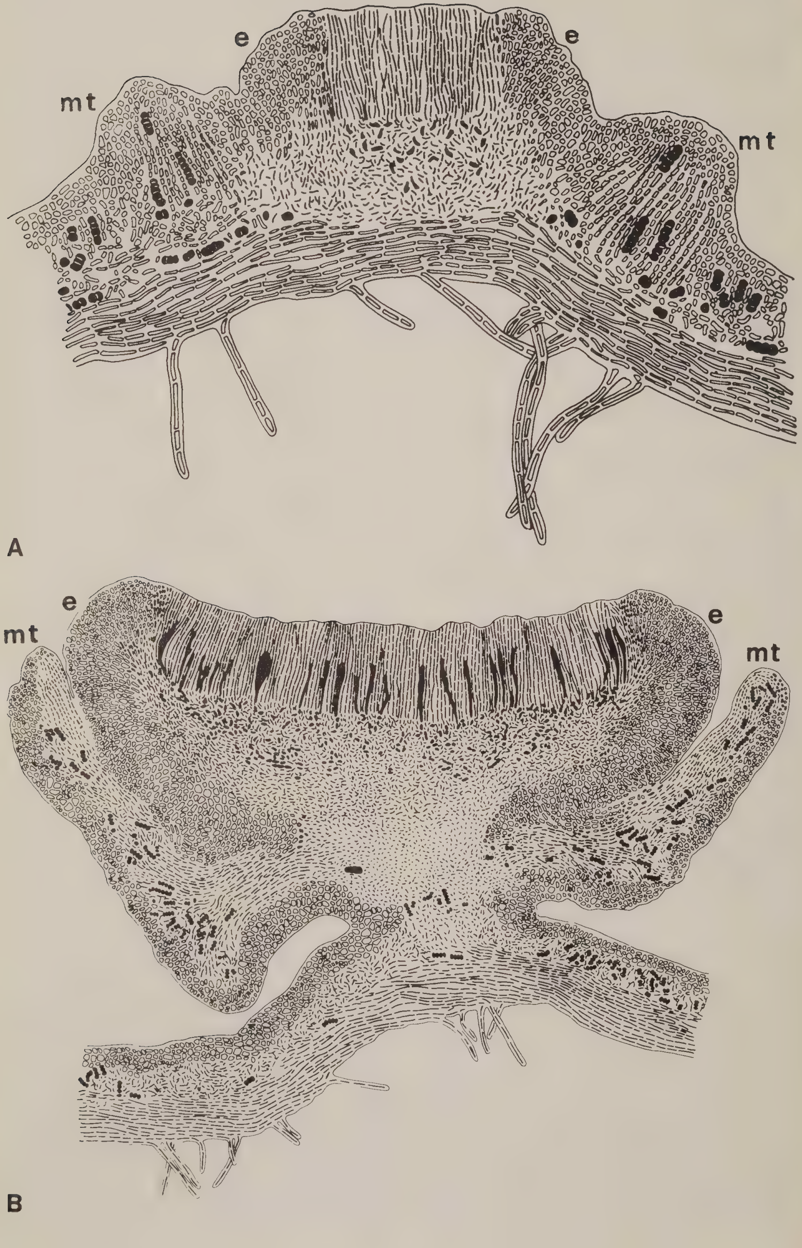
MATERIAL AND METHODS

Material. The abbreviations of herbaria follow those given in *Index Herbariorum*.

Parmeliella duplomarginata: see below: - *P. gayana*: (Mont.) Müll. Arg. Chile, prov. Arique, 1851 Lechler no. 641 (MB). - *P.plumbea* (Lightf.) Vain: British Isles, Scotland, Inverness Co., Dorlin, 1964 Henssen no. 17484d (MB).- Portugal, Azores, Pico, 1978, Henssen no. 26050b (MB); São Miguel, Furnas, 1977, Henssen no. 25511a (MB). *Psoroma* n.sp. Auckland Islands, Auckland Island, Ranui Cove, Observation Point Plateau. 1962, James no. 694A (BM); between Meggs Hill and Ranui Cove, 1962 James no. 755A (BM); - Rose Island, Grey Duck Creek, on *Fuchsia ecorticata*, 1963 James no. 993C (BM). - New Zealand, South Island, Hunter Valley, Boil the Billy Creek, on *Nothofagus*, 1963 James no. 1393B (BM).

Morphology. Samples were sectioned by freezing microtome and the sections mounted in lactophenol cotton-blue. Measurements of spores and anatomical structures were made

Fig. 1. Habit photographs of *Parmeliella duplomarginata* (A,B, James 1402; C-F,H,I holotype; G, Murray 4048). A, marginal part of the thallus with apothecia with a simple margin (x 6); B, apothecia surrounded by an excipulum proprium only at higher magnification (x 13.5; an area of secondarily developed thalline margin is indicated by an arrow); C, part of the thallus with numerous apothecia and aggregated pycnidia (x 4.5); D, young apothecia with urceolate discs and double margins (x 15); E, large apothecium with a double margin (x 15); F, apothecium with pycnidia in the margo thallinus (x 15); G, central part of the thallus (x 6); H, aggregated "stalked" pycnidia (x 15). I, finely striated lobe bearing numerous pycnidia and a young apothecium (x 15).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from permanent preparations; measurements of gross morphology on air-dried specimens. For studying the ascus structure KI_3 solution was added directly to the squash preparation or after pretreatment with 10% KOH.

Chemistry. Crude lichen extracts were chromotographed in solvent systems A,B and C of Culberson (1972).

TAXONOMIC PART

Parmeliella duplomarginata P.James et Henssen, sp. nov. Fig. 1-4.

Diagnosis. Thallus rosulatus, usque ad 10 cm latus, plus miusve adpressus, caeruleo-griseus, subtus pallidus vel nigricans, rhizinis villoso-vestitus. Lobi usque ad 1 cm lati, in margine radiati et subtiliter striati.Hyphae horizontaliter ordinatae. Apothecia laminalia, usque ad 1.7 mm lata,excipulo proprio et margine thallode circumdata. Sporae 8nae, eseptatae, incolores, ellipsoideae vel subglobosae, (10-)12-16 x (7-)8-11µm. Pycnidia saepe submarginalia aggregata, 0.25 - 0.5 mm lata. Conidiophora ramosa et brevicellularia, conidia lateralia et terminalia formantia. Conidia bacilliformia, 3-5 x 0.5-1µm. Alga at genus *Scytonema* pertinens.

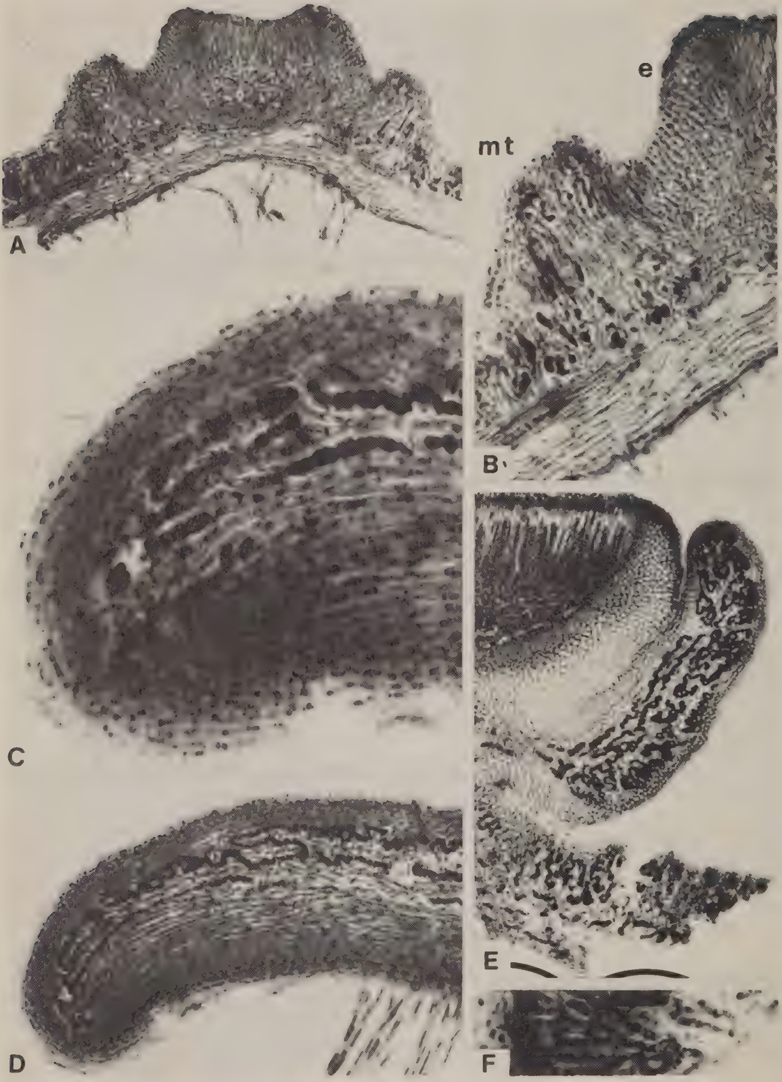
Chemistry: no substances of taxonomic value were detected.

Typus: New Zealand, North Island, Volcanic Plateau Bot. Distr., Rotoiti Bush, S.E. of Lake Rotoehu, in crown of fallen rimu in rimu-tawa-forest, 1929, G. Einar & Greta Du Rietz no. 3117 (Holotypus: UPSV; isotypi: BM, MB).

Further specimens examined: New Zealand, North Island Volcanic Plateau Bot. Distr., Ruapehu, above Whakapapa Huts, on a big shrub of *Olearia nummularifolia* on a *Danthonia* tussock plain between the uppermost tongues of *Nothofagus cliffortioides* forest, 1927, G. Einar & Greta Du Rietz no. 3180 (BM, UPSV); - South Island, Southland, Fiord Co., Secretary Island, on shrub at 1000 m, 1959, Murray no. 4048 (BM,CHR); Wilmot Pass, on shrub in a swamp at 500 m, 1959, Murray no. 3928 (BM); Otago, Vincent Co., above Lake Hawea, Hunter Valley, Lake Creek, on isolated *Nothofagus*, 1963, James no. 1402 (BM).

Thallus, rosette-shaped, up to 10 cm diam, pale-grey to blue-grey, attached by a thick felted mass of pale or bluish rhizoidal hyphae and "rhizoptae" (sensu Hannemann 1973). Lobes up to 1 cm broad, distinct and radiating towards the marginal part, contiguous and over-

Fig. 2. Development of the double margin in *Parmeliella duplomarginata*. A, young apothecium, B, mature fruitbody. - e excipulum proprium, mt margo thallinus (reproduced from Henssen & Jahns 1973).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lapping for most of their length within the inner parts of the thallus, margins often secondarily notched or indented often forming secondary lobuli and corrugations in the older parts of the thallus (Fig. 1C,G). Upper surface undulate, young lobes faintly striate at the margins (Fig.1I).

Thallus sections 130-190µm thick, covered by a thin gelatinous or necrotic layer. Hyphae basically in a periclinal arrangement throughout the thallus, forming a primitive upper cortex, 20-30µm high composed of 4-5 rows of cells with cuboidal or shortly rectangular cells, in size 6-10 x 5-7 µm, walls uniformly thick. Algal zone c.50-70µm, with loosely interwoven medullary hyphae surrounding the filaments of the *Scytonema* phycobiont, algal filaments 9-12µm broad with intercalary heterocysts. Medullary hyphae gradually compacted towards the lower surface of the thallus were they form a layer of c.5-8 markedly adglutinated hyphae with thickened longituadinal walls, cells 12-25µm long, becoming shorter where they develop into rhizoidal hyphae. Rhizoidal hyphae c.5-8µm thick, thick-walled (Fig. 3D,4C), united to form rhizoptae towards the thallus centre.

Apothecia scattered or more frequently contiguous, up to 1.7 mm diam, becoming markedly sessile. Disc flesh-coloured to dark-brown, concave or lateron plane, surrounded by an excipulum proprium, c.0.1 mm thick, and usually an additional thalline margin, up to 1.5 mm thick (Fig.1C-E). Hymenium 90-115µm tall, upper part of the hymenial gelatine brown. Subhymenium inverted cone-shaped, 180-200µm high, extending downwards into a tall stipe, up to 220µm in height, which originates from medullary hyphae and forms an internal supporting tissue between the inner edge of the excipulum proprium. Hyphae in the supporting tissue and stipe densely interwoven, hyphal walls gelatinized (Fig.4D, E). Excipulum proprium c.100µm thick, composed of radiating hyphae. Margo thallinus 120-150µm thick, corticate on both, the inner and outer face (Fig. 3E,4D), lower cortex at the base up 70µm thick. In old apothecia thalline margin partly touching or firmly interconnected with the proper margin. Asci cylindrical, 80-100 x 10-15µm amyloid, wall thickened at the apex. Spores 8 per ascus, colourless, simple ellipsoid or subglobose, (10-)12-16 x (7-)8-11µm, wall thick, surface rugose. Paraphyses simple or occasionally branched in the upper part, c.2µm thick, short celled at the tips.

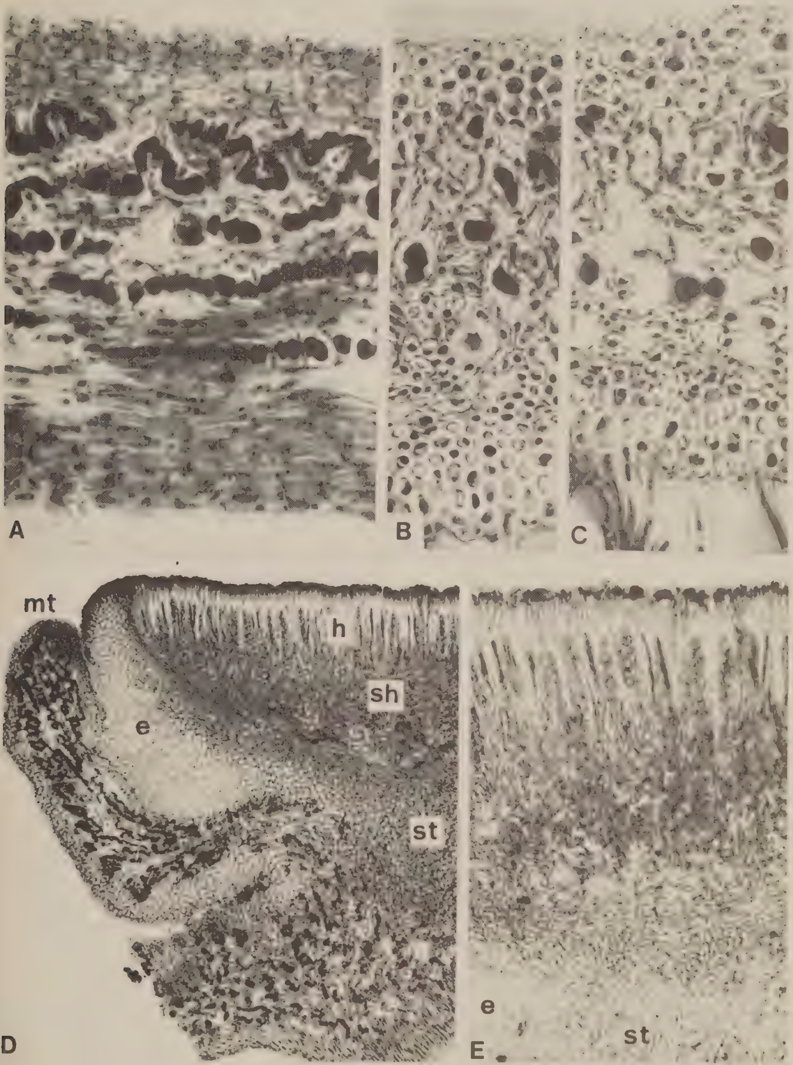
Fig. 3. Anatomy of *Parmeliella duplomarginata* (A,B, James 894A; C-F, holotype). A, young apothecium with the margo thallinus developing at some distance from the excipulum proprium (x 100); B, part of the same stage at a higher magnification (x 200); e excipulum proprium, mt margo thallinus); C-D, l.s. of lobe tip (x 500 and x 200), the filaments of *Scytonema* are incorporated in the layers of periclinally arranged thalline hyphae; E, part of an apothecium with double margin (x 100); F, conidiophores and conidia (x 500). (A, reproduced from Henssen 1969).

Pycnidia contiguous, mainly along the margins and ridges of the lobes (Fig. 1C,G), occasionally even in the margo thallinus of old apothecia (Fig. 1F), 0.25-0.5 mm diam, elevated in an outgrowth of the thallus finally becoming more or less stalked (Fig. 1F,H,I). Conidiophores branched and short-celled, conidia formed laterally and terminally (Fig. 3F). Conidia rod-shaped, 3-5 x 0.5-1µm.

The new species is somewhat variable. With regard to colour of the upper surface specimens range from pale blue-grey to pale olive and older parts of the thallus sometimes become partly blackened. In exposed, sunny sites, the thallus can be partly indigo-blue. In form the placoid-lobate habit is usually characteristic but in exposed situations the lobes often become elongated and tend to lack the development of secondary lobes towards the centre of the thallus characteristic for specimens of more sheltered habitats. Likewise in open situations the densely rhizinose undersurface is generally more intensely pigmented and often conspicuously blue-black, while in sheltered habitats the underside may be entirely pale or cream-coloured.

Most species seen are well fruited; the disc may be very pale orange-brown, but is more often dark brown in plants in exposed sites. The degree of development of the margo thallinus is very variable; in some specimens only part of the fruits have a fully developed thalline margin and in such cases only some uneven and irregular upgrowths surrounding part of the apothecium may be present (Fig. 1B, arrow); rarely, no margo thallinus is developed at all (Fig. 1A,B). When well developed, the thalline margin forms a supplementary, more or less crenulate surround for the otherwise lecideine apothecium so that only the upper part

Fig. 4. Anatomy in *Parmeliella duplomarginata*. A, l.s. of thallus with primitive upper and lower cortex, the latter composed of aggregated medullary hyphae (x 500); B-C, t.s. of thallus (x 500); D, marginal part of a large apothecium, the stipe composed of densely interwoven hyphae forming a supporting tissue (x 100); E, central part of a similar stage (x 500). - e, excipulum proprium; mt margo thallinus; h, hymenium; sh, subhymenium; st, supporting tissue.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of the pale brown proper margin of the fruit is exposed (Fig. 1D,E). Occasionally the entire proper margin may be obscured by the thalline margin (Fig. 1G). Initially the margo thallinus arises at some distance around the developing excipulum proprium (Fig. 2A,3A,B). In later stages of development the basal parts of proper and thalline margin are more or less intimately connected (Fig. 3E,4D).

The formation of a supporting tissue by medullary hyphae connecting the inner edge of the excipulum proprium corresponds to similar structures described for species of the *Parmeliella pycnophora*-group and *Erioderma* (Keuck 1977).

In *Parmeliella duplomarginata* the hymenial gelatine stains blue in iodine solution. The slimy outer part of the ascus wall is directly positive but the thickened apex only colours after pretreatment with KOH solution. The reaction in the apex is variable: in young asci an amyloid plug may be observed; in mature asci an inner closed or perforated amyloid cap, or more rarely, a faint coloration of the whole apex may be demonstrated. Similar variations were noted in a comparative study of the asci in *P.gayana* and *P.plumbea*. An inner amyloid cap perforated by a pore has previously been observed in *P.plumbea* by Keuck (1977), p.105), while Jørgensen (1978,p.90) describes an amyloid plug. In one of the specimens of *P.plumbea* studied by us (Henssen no. 17484d) the entire apex stained bluish in most of the asci. Variation of this kind in the iodine reaction has recently been discussed by Nannfeldt (1976) and is considered to be related to the age of the ascus and the mode of iodine treatment.

Ecology and distribution. *Parmeliella duplomarginata* is widely distributed in New Zealand; it has also been collected from most islands of the Auckland Islands as well as from Campbell Island. It is a species of rather open situations, often at the edge of *Nothofagus* forests especially on the eastern side of the main mountain ranges of New Zealand. It occurs on a wide range of phorophytes from sea level to 1000 m and often grows with *Menegazzia* species, especially *M. pertransita*, in the crowns of mature trees; it has also been collected from rocks. In the Auckland Islands it often occurs on twigs and branches of *Myrsine divaricate-Coprosma foetidissima*-scrub in lowland or coastal areas, often with *Pseudocyphellaria aurata*, *P. intricata*, *Parmeliella amphibola*, *P.pycnophora*.

Systematic position. In its thallus and habit *Parmeliella duplomarginata* resembles other lobate-placoid species of the family, for example *P.plumbea* and *P.gayana*, species belonging to that group of the genus in which the lower medullary hyphae are horizontally extended (Keuck 1977). With regard to these species a true close relationship obviously exists between *P.gayana* and *P.duplomarginata*. In both species the hyphae are basically periclinally arranged throughout the thallus, a feature which is especially distinctive in the tips of the lobes (Fig. 3C,D, 4A-C), the phycobiont is a *Scytonema* species, and the rhizinose felt on the undersurface is composed of rather distinct rhizoidal hyphae and rhizoptae. In contrast, the hyphae in *P.plumbea* only are strictly periclinally arranged in the lower part of the thallus being anticlinally ordered towards the upper surface where they form a cortex of isodiametric cells; this particular arrangement can be recognized already in the tips of young lobes in *P.plumbea*. In *P.plumbea*, furthermore, the phycobiont is *Nostoc*, and the thallus lower side is covered by a thick felt of intertwined rhizoidal hyphae and rhizoptae designated as erioastrum (Hannemann 1973) or hypothallus (Jørgensen 1978) respectively. *P.gayana* and *P.duplomarginata* correspond also in the anatomical structure of the apothecium: In both species the inner edges of the excipulum are connected by a supporting tissue formed by medullary hyphae, a character shared with species of the *Parmeliella pycnophora*-group and *Erioderma*. *P.duplomarginata* principally differs from *P.gayana* in possessing an additional thalline margin which surrounds the excipulum proprium. A similar development of a double margin occurs in certain other species of the *Pannaria-Parmeliella-Psoroma*-complex as, for example, in *Parmeliella periptera* and *Pannaria immixta*. In so far as these species have been examined, there appears to be no close relationship to *Parmeliella duplomarginata*. This suggests that the formation of a double margin in these species is the result of convergent evolution in several systematic groups in this generic complex. The systematic position of the entire group needs further careful study and the formulation of new concepts (cf. Jørgensen 1978). In connection with this observation it is of interest to mention that one of the species with a double margin, as yet undescribed, from the Auckland Islands (James 694A), is obviously closely related to certain squamulose species of *Psoroma* in spite of having blue-green alga as its phycobiont. In our estimation the use of the phycobiont as a means of generic delimitation has been overestimated in the *Pannaria-Parmeliella-Psoroma-Psoromaria*-complex.

Although there may be justification for the separation of *Parmeliella gayana* and *P.duplomarginata* as a separate genus, at the present time we feel that the knowledge of the three genera is still too fragmentary to effect this separation.

ACKNOWLEDGEMENTS

These studies were partly supported by a grant of the Deutsche Forschungsgemeinschaft given to one of us (A.H.). We are indebted to Bernd Renner to check the presence of lichen substances in the new species and to Mrs. Traute for technical help.

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ARUALIS CAROLINENSIS KATZ, GEN. ET SP. NOV.

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ABSTRACT

The new genus and species *Arualis carolinensis* is described from *Pinus taeda* L. needles in North Carolina.

INTRODUCTION

During an investigation of the microfungi associated with loblolly pine (*Pinus taeda* L.) needles, several new and interesting fungi were isolated. Among them, a new imperfect state of a basidiomycete was discovered, which is described below as a new genus.

TAXONOMIC PART

Arualis Katz, gen. nov.
Deuteromycotina, Hyphomycetes

Coloniae tarde crescentes, leves, compactae, ochroleuco-brunneae, hyphis aereis sparsis. Hyphae zygodesmatibus praeditae, leviter tunicatae. Aleuroconidia a parte superiore zygodesmatum singillatim orta; cellulae conidiogenae interdum in ramis brevibus erectis congregatae. Conidia hyalina, levia, cylindrica, basi truncata, 1-2 cellularia, tenuiter tunicata.

Species typica: *Arualis carolinensis*

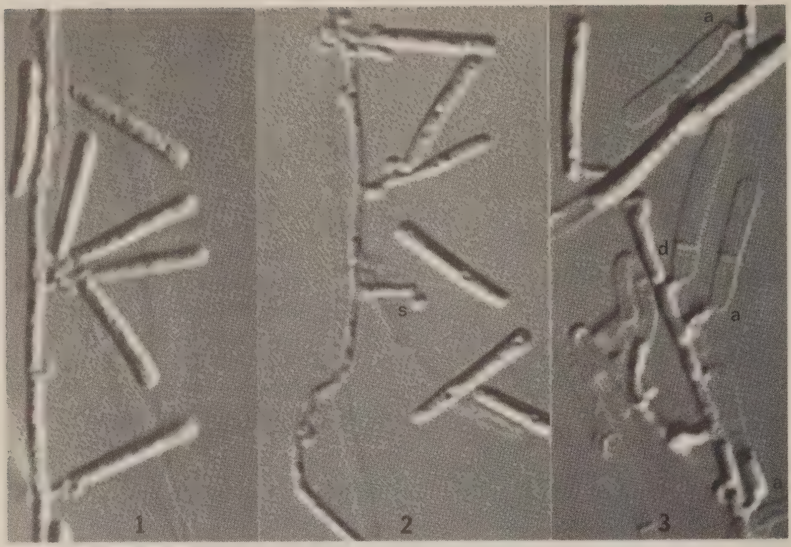
Colonies slow-growing, appearing flat and compact, tan-brown, with sparse aerial hyphae. Hyphae bearing clamp connections, smooth-walled. Aleuroconidia originating from distal ends of clamps, one per clamp; conidiogenous cells may be clustered on short perpendicular branches. Conidia hyaline, smooth, cylindric, with truncate bases, 1-2 celled, thin-walled.

Arualis carolinensis Katz. sp. nov.

Coloniae in agaro cum malto composito satae sub calore 20-23° die quinto decimo diametrum 17-19 mm attinentes, leves, compactae, brunneae (colore brunneo martio sensu Ridgway), margine hyalino, hyphis aereis sparsis. Hyphae immersae compactae, leves, zygodesmatibus praeditae, ad 2 µm crassae, cellulis vulgo 18-30 µm inter zygodesmata longis, nonnumquam a septis adventitiis subdivisis. Hyphae aereae angulis acutis vel rectis ramosae, plerumque 18-30 µm inter zygodesmata longae, a septis adventitiis subdivisae, hyalinae, leves, raro fertiles. Loci conidiogeni singulares, in parte superiore zygodesmatum, zygodesmatibus conidiogenis nonnumquam in ramis hypharum brevibus congregatis. Conidia quidem aleuroconidia, hyalina, levia, tenuiter tunicata, cylindrica, 1.5 - 2.5 X 8 - 13 µm, 1-2-cellularia, cicatricibus basalibus truncatis ornata. Sub calore 37°C nullus auctus.

On decomposing needles of *Pinus taeda* L., North America. Collection from *P. taeda* stand, Saxapahaw, Alamance county, North Carolina, April 22, 1977, by B. Katz. Holotypus: BAK #39. The name *Arualis* was invented for the genus. Its gender is feminine.

Colonies on malt agar at 20-23°C attaining a diameter of 17-19 mm in 14 days, flat and compact, mars brown (Ridgway), margin hyaline, aerial hyphae sparse. Submerged hyphae compact, smooth, bearing clamp connections, up to 2 µm wide, cells usually 18-30 µm between clamp connections, adventitious septa sometimes dividing these cells. Aerial hyphae acutely to perpendicularly branched, usually 18-30 µm between clamps, with adventitious septa, hyaline, smooth, infrequently fertile. Conidiogenous loci on distal ends of clamps, one per clamp, conidiogenous clamps sometimes clustered on short hyphal branches. Conidia are aleuroconidia, hyaline, smooth, thin-walled, cylindrical, 1.5 - 2.5 X 8-13 µm 1-2 celled, with truncate basal scars. Growth absent at 37°C.



Figures 1-3. 1. Hyphae with clamp connections, aleuroconidia developing from a solitary clamp and from a cluster of clamps. 2. Clamp connection after conidium has seceded (s). 3. Four conidia anastomosed to original mycelium. Three have germinated at edge of attachment scar (a) - in one, the cytoplasm remains in one cell. The fourth has germinated from the end distal to the attachment scar (d). 1,250X.

DISCUSSION

This fungus has a unique asexual state characterized by solitary, 1-2 celled aleuroconidia borne on the distal end of clamp connections (figures 1 and 2). When the conidia secede they leave conspicuous scars on the clamp connections (figure 2). Germinating conidia produce hyphae and will readily anastomose with the original mycelium (figure 3).

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RHYTISMATACEAE ON SALAL LEAVES

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SUMMARY

Four Rhytismataceous fungi occur on leaves of salal (Gaultheria shallon Pursh). One, Lophodermium schweinitzii, had been reported as both L. schweinitzii and L. exaridum. A second species, Hypoderma gaultheriae sp. nov., had been reported as Lophodermium sp. The third and fourth, Coccomyces tumidus and C. dentatus had been reported as C. coronatus.

Gaultheria shallon, salal, is an ericaceous shrub that occurs in forested coastal areas from California northward to Alaska. It is used by florists and in British Columbia (B.C.), it has an annual retail value of $1-3 million. Rhytismataceae (Korf 1973) reported on leaves of this host are Lophodermium exaridum (Cke. & Pk.) Sacc. from California (Anonymous 1960), L. schweinitzii M. Wils. & Robertson from Oregon and Washington, Coccomyces coronatus (Fr.) Karst. from Washington (Shaw 1973), and Lophodermium sp. from B.C. (Lowe 1977). There are two collections in the herbarium of the Pacific Forest Research Centre (DAVFP) of the latter and although a recent collection on G. shallon from B.C. superficially resembled these (Figs. 1 and 2), it bore long stalked asci, typical for the genus Hypoderma. To clarify the identification of this new fungus and the reported Lophodermium sp., specimens of L. exaridum on G. shallon and Kalmia angustifolia L. were examined from the herbarium of the University of California (UC). Specimens of *L. schweinitzii* on *G. shallon* reported by Shaw (1973), could not be located.

Morphologically, specimens of *L. exaridum* on *K. angustifolia* fit Tehon's (1935) description of the fungus species. However, specimens identified as *L. exaridum* on *G. shallon* are clearly different (e.g. hysterothecia and asci almost twice as large in the specimen on *G. shallon*) from both the specimens on *K. angustifolia* and Tehon's (1935) description. Also, this fungus is not a *Hypoderma* sp., but clearly fits the description (Wilson and Robertson 1949) for the reported (Shaw 1973) *L. schweinitzii* (Fig. 3). Of the described *Hypoderma* spp., the one on salal is most similar to *H. virgultorum* DC. (=*H. rubi* (Pers.) de Not.), but has smaller hysterothecia, wider spores and aseptate paraphyses. The *Hypoderma* on salal is described below as a new species.

Hypoderma gaultheriae sp. nov. (Figs. 1, 2, 5-8).
Teleomorpha: Hysterotheciis conspersis hypophyllis, subcuticularibus intra folii necromaculas, ellipticis, atronitidis, 700-1100 x 350-500 um latis, 230-325 um altis; labiis atronitidis, 100-150 um latis, incrassatis elevatisque supra hysterothecias cum aperturis longitudinalibus; tectis plectenchymatis, fuscis, cum crassae parietis cellulis, 10-20 um altis, continuis contiguisque cum basilari pseudoparenchyma, ipsa fusca, cum crassae parietis cellulis, 25-35 um altis; periphysibus non vidis; hymenio albo in aperta hysterothecia, usque ad 200 um alto; ascis clavatis, attenuiter pedicellatis longatis, (52)95-115(137) x (8.5) 9.5-10.5(12.5) um, octoascosporis; paraphysibus simplicibus, filiformibus, nonnunquam apicis afflatis, 95-150 x 1-2 um; ascosporis brevis, fusiformibus, strictis vel curvatis apice late vel anguste sphaerica, saepe cum medio pseudoseptato a media vacuola formatibus 19-26 x (2.5)3.5-6.5 um; vaginis mucosis ascosporarum circumvolutis, 1.0-1.5 um.

Anamorpha: Pycnidiis atronitidis dispositis pariter quam hysterotheciis, 100-150 um. Conidiophoris simplicibus, 14-16 x 1.0-1.5 um. Conidiis holoblastis, hyalinis, ellipsoideis, 1.0 x 3.0 um.

Holotypus: DAVFP 22097, in *Gaultheria shallon* Pursh.

Teleomorph: Hysterothecia scattered within necrotic leaf spots, elliptical, shining black, 700-1100 x 350-500 um, hypophyllous, subcuticular, 230-325 um thick; labia shining black, 100-150 um wide, thickened and elevated above the hysterothecium, opening with a longitudinal slit to expose the whitish hymenium, periphyses not seen; basal pseudoparenchyma 25-35 um thick; hymenium hyaline, up to 200 um thick; epidermis dark brown, thick walled plectenchyma continuous and intergrading with the basal pseudoparenchyma, 10-20 um thick; asci clavate, tapering to a long fine stipe, (52)95-115(137) x (8.5)9.5-10.5(12.5) um, 8-spored; paraphyses simple, numerous, flexuous filaments sometimes with swollen tips or sometimes uncinate, 95-150 x 1-2 um; ascospores short, fusiform, straight or curved, tips broadly or narrowly rounded, 19-26 x (2.5)3.5-6.5 um with a 1-1.5 um gelatinous sheath, frequently with a medial pseudoseptum, formed by a central vacuole.
Anamorph: Pycnidia scattered within necrotic leaf spots and produced before hysterothecia appear; shiny black, 100-150 um, hypophyllous, subcuticular. Conidiophores long and straight, 14-16 x 1.0-1.5 um. Conidia holoblastic, hyaline, ellipsoid, up to 1.0 x 3.0 um.

Collections examined: C.S. Wood & R.S. Hunt, Copper Canyon Road at Trans Canada Highway, Chemainus, B.C., 26.IV.1978. DAVFP 22097 (Type). J.E. Bier, Lake Cowichan, B.C., V.1941. DAVFP 2089. W.G. Ziller, Lake Cowichan, B.C., 7.VI.1949. DAVFP 4651. 16.VII.1957. DAVFP 22158. Youbou, B.C., 8.VI.1949. DAVFP 4611. R.S. Hunt, Lake Cowichan, B.C., 21.VIII.1979. DAVFP 22096. Sooke, B.C., 25.V.1979. DAVFP 22098. Cumberland, B.C., 6.VII.1979. DAVFP 22099. Port Renfrew, B.C., 28.IX.1977. DAVFP 21555. C.S. Wood & W. Nijholt, Caycuse, B.C., 3.IV.1979. DAVFP 22105. J.A. Calder & K.T. MacKay, Heriot Bay, Quadra Is., B.C., 5.V.1951. DAOM 172767. J.A. Calder, D.B.O. Savile & R.L. Taylor, Masset, Q.C.I., B.C., 3.V.1957. DAOM 172768. Moresby Logging Camp, Q.C.I., B.C., 30.V.1957. DAOM 172769. Langara Is., Q.C.I., B.C., 15.VII.1957. DAOM 172771. J.A. Calder & R.L. Taylor, White Creek Muskeg, Q.C.I., B.C., 7.V.1964. DAOM 172770. K. Egger, Tlell, Q.C.I., B.C., 17.VI.1979. DAOM 172534.

Legends to Figures

FIG. 1. Hysterothecium and pycnidia of a Lophodermium sp. reported on Gaultheria shallon from B.C.

FIG. 2. Hysterothecium and pycnidia of Hypoderma gaultheriae on Gaultheria shallon.

FIG. 3. Hysterothecium of Lophodermium schweinitzii on Gaultheria shallon from California.

FIG. 4. Polygon shaped hysterothecium of Coccomyces dentatus on Gaultheria shallon.

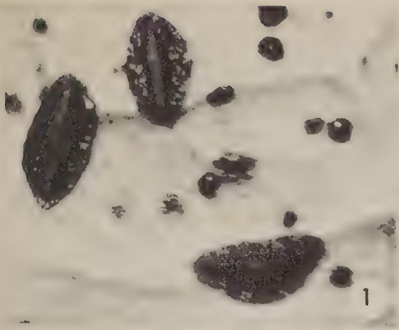
FIG. 5. Cross-section of Hypoderma gaultheriae showing the hymenium in the dark hysterothecium. X176.

FIG. 6. Long stalked asci and flexuous paraphyses of Hypoderma gaultheriae. X396.

FIG. 7. Ascospores of Hypoderma gaultheriae showing the pseudoseptum. X396.

FIG. 8. Cross-section of a pycnidium of Hypoderma gaultheriae. X396.

Attempts to germinate Hypoderma gaultheriae ascospores from air-dried collections were unsuccessful. However, similar cultures were consistently obtained from hysterothecia tissue, pycnidia and blackened veins from the Chemainus and Sooke collections. The fungus grew slowly on potato dextrose agar, between 5-25°C with an optimum at 21°C, where a 9-cm petri plate was covered in 35 days. Initially, most mycelium was appressed to the agar and was beige colored. Gradually, the centre of the colony became brown with white floccose hyphae above and beige colony margins. Later, the floccose mycelium became slightly beige with a white margin. On the reverse side, the culture was beige with scattered darker areas. Irregular shaped sclerotia eventually developed in the darker areas. Hyaline to light brown hyphae were 1(2) um wide, straight or twisted and predominantly branched at right angles. Brown hyphae were 5-12 um wide and branched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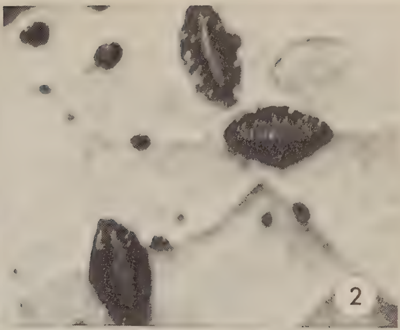
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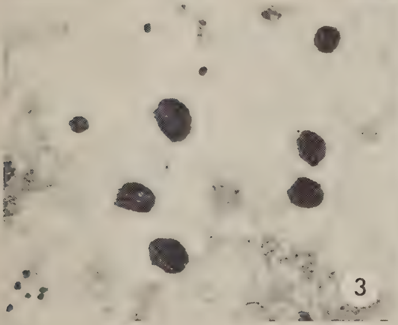
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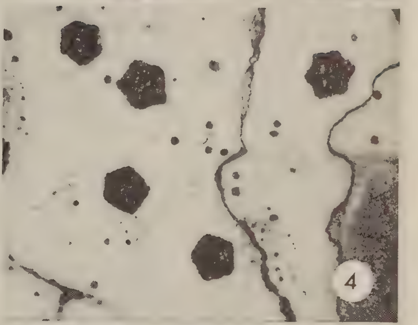
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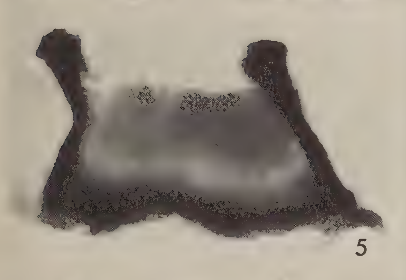
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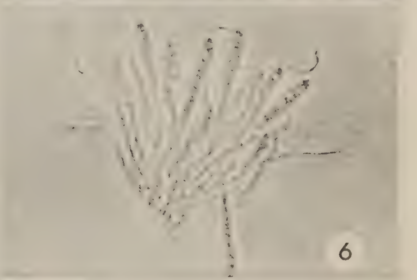
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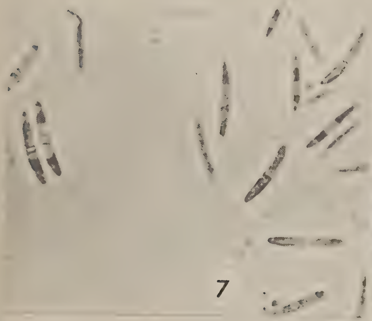
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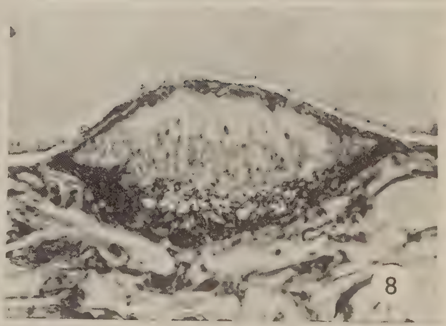
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irregularly. Cross walls were frequent at irregular intervals. No fructifications were observed at room temperature in plates kept for 6 months.

The necrotic lesions associated with *H. gaultheriae* are on green leaves, and have an associated anamorph, whereas *L. schweinitzii* lesions are on dead leaves, and apparently lack an anamorph. Lesions of *H. gaultheriae* commonly had masses of dark plectenchymatous tissue within some host veins so that the veins on the top and bottom of the leaves were blackened. A few blackened veins were observed once in association with *L. schweinitzii*. The shape of *H. gaultheriae*'s hysterothecia tended to be more narrowly ellipsoid (Fig. 1), whereas *L. schweinitzii*'s tended to be broadly ellipsoid (Fig. 3).

Hypoderma gaultheriae can be recognized readily in the field by the following signs and symptoms: a) generally large lesions on green leaves, b) black veins within the lesions, c) subcuticular pycnidia, d) narrowly ellipsoid shiny black hysterothecia, and e) infection of a small radiating patch of plants. In many instances, it appears to be secondary to leaf mining moths or *Valdensinia heterodoxa* Peyronel.

Neither asci nor spores were observed in the two specimens labelled *Lophodermium* sp. from *G. shallon* in herbarium DAVFP (nos. 4611 and 4651). However, they are on green leaves, and have subcuticular pycnidia associated with more narrowly ellipsoid hysterothecia (Fig. 1) and some blackened veins. These characteristics place the fungi into *H. gaultheriae*. Recently, parts of these collections have been identified as *Hypoderma* by DAOM taxonomists (Shoemaker pers. comm.).

Mixed in with two of the collections of the *L. schweinitzii* from California, but in separate lesions, are a few distinct *Coccomyces* hysterothecia. These are irregular trapezoids or polygons and open radially by 3-7 slits (Fig. 4). The ascospores are non-septate. Among a collection of unidentified fungi on *G. shallon* in DAVFP, two additional collections of this fungus were located. There was also an association with *L. schweinitzii*. This *Coccomyces* sp. lacks the ellipsoid to round hysterothecia and multiseptate spores (Dennis 1978), distinctive of the reported (Shaw 1973) *C. coronatus* on *G. shallon*.

Shaw (1973) regards *C. dentatus* (Kunze & Schum. [sic]) Sacc. as a synonym of *C. coronatus* whereas Sherwood (1979) treats them separately, as does Dennis (1978). Specimens at DAVFP fit the description for *C. dentatus* (Rehm 1896), except that the asci and ascospores are considerably larger. Specimens of the reported *C. coronatus* were obtained to clarify their identification and compare them to DAVFP specimens. None of these *Coccomyces* were on the same leaves as *L. schweinitzii*. Two of these specimens could be identified as *C. coronatus*; however, Sherwood (1979) has shown that many specimens identified as *C. coronatus* should be called *C. tumidus* (Fr.) de Not., as should the specimens on salal (Sherwood pers. comm.). Two specimens appeared to be conspecific with the B.C. and California specimens, and measurements of the asci and ascospores bridged the range given for *C. dentatus* (Rehm 1896). Sherwood (pers. comm.) has identified *C. dentatus* on salal leaves, and I believe the specimens I examined fit an expanded concept of the species. Measurements on salal of *C. dentatus* asci are 56-139 x 8.8-12.6 and ascospores 44-69(84) x 1.6-2.5 um.

In the field, *C. dentatus* on salal is readily distinguished from *C. tumidus* by its polygon-shaped apothecia whereas *C. tumidus* has round to ellipsoid apothecia.

The known Rhytismataceous fungi on *G. shallon* leaves are *Lophodermium schweinitzii*, *Hypoderma gaultheriae*, *Coccomyces tumidus* and *C. dentatus*.

Acknowledgements

I wish to thank Drs. I. Tavares, R.A. Shoemaker and C.G. Shaw for loaning specimens and making helpful observations, and Dr. M.A. Sherwood for taxonomic comments.

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MYCOTAXON

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THE ACANTHOCYTE, A UNIQUE CELL TYPE IN STROPHARIA (AGARICALES)

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INTRODUCTION

In the course of culturing species of the agaric genus Stropharia (Fr.) Quél., I observed an unusual cell type on the vegetative mycelium which I have named the acanthocyte. This paper discusses the morphology and development of this cell type in pure culture and its occurrence and distribution among Stropharia species in herbarium specimens.

MATERIALS AND METHODS

Cultures. Acanthocytes are found on both monocaryotic and dicaryotic mycelium. The growth and development of acanthocytes were observed on a medium composed of 1.5% malt extract and 1.5% agar in 60- or 110-mm petri dishes. In some cases 3-mm square pieces of sterilized dialysis tubing were placed over the agar surface. After it was overgrown by mycelium, the tubing was removed and the adhering mycelium examined microscopically. Early developmental stages were more easily photographed if they were first stained in phloxine (1% in H_2O).

For SEM observation, 1- to 2-cm segments of agar containing the fungal mycelium were removed from petri dishes and placed in vials containing fixative (2% paraformaldehyde and 3% glutaraldehyde in a 0.1 M sodium phosphate buffer, pH 7.2). After 2 hours of fixation, specimens were dehydrated in an alcohol series and critical point dried from liquid carbon dioxide. Agar segments with fungal hyphae exposed were mounted on stubs and coated with gold-palladium in a Hummer II sputtering device. Coated specimens were viewed in a Hitachi HHS-2R scanning electron microscope.

Herbarium Specimens. A small amount of vegetative mycelium and associated substrate was removed from the base of the stipe and placed on a microscope slide. A drop of 1% potassium hydroxide was added before adding a cover slip.

MORPHOLOGY AND DEVELOPMENT IN CULTURE

Initial attempts to observe the development of the acanthocyte *in situ* via specialized growth chambers met with little success. Therefore the developmental sequence presented is a composite picture derived from observing several cultures at different times in their growth.

Figures 1-27 outline the development of the acanthocytes. These cells develop only above or on the agar surface. The formation of a short lateral branch more or less at right angles to the parent mycelium is the first sign of the differentiation of an acanthocyte. The apex of this side branch produces several short branches. (Figs. 1-5). At this point a cross wall has generally been formed which delimits the side branch from the parent mycelium. In dicaryotic cultures this cross wall will be associated with a clamp connection. Traces of a crystalline material now become apparent as a thin deposit along the outer wall (Figs. 6-9, 27). Initial deposition generally occurs in a more or less uniform layer. Later deposition, however, is more irregular with the formation of discrete crystals over the outside of the cell (Figs. 10-16, 22-25). These crystals may be so abundant that the apex of the cell appears surrounded by a small clump of "rocks." The apical branches can be completely hidden by the crystalline deposition.

At this point the branches elongate becoming thin cylindrical projections (Figs. 11-16). As the branches grow crystalline material is deposited along the outer walls (Figs. 22, 23, 25, 26). This results in an initially thick, smooth deposit that gradually narrows to an acute apex just beyond the tip of the branch. Discrete crystals are not generally formed along the branches. Deposition around the branches is not uniform so that one side often has a thicker layer of crystalline material than the other (Figs. 22, 25, 26). The width of an acanthocyte, the distance between the tips of the two most distant arms, varies from 50 to 125 μm.

The end result is the formation of "spiny" cells (Figs. 17-21, 24, 26) scattered over the surface of the mycelium in the agar dish. For this reason the term acanthocyte is being used to refer to these structures. The foregoing description was based on cultures of Stropharia rugosoannulata Farlow (DF2575). In addition acanthocytes have been seen in cultures of S. ambigua (Pk.) Zeller, S. hornemannii (Fr. ex Fr.) Lundell & Nannf., S. coronilla (Bull. ex Fr.) Quél., and S. hardii Atk.

While the above discussion outlines the most common developmental pattern, there is variation at some stages. This is reflected in the morphology of the mature cell. The major deviation involves the degree and type of branching that occurs at the apex of the short lateral branch. Generally the branching is restricted to the apex. But in some cases branches may be formed along the length of the lateral branch (Fig. 5). Occasionally cells may form only two or three branches (Fig. 19). In both cases the mature structure has a more open morphology. The amount of crystal formation at the apex of the lateral branch also varies (compare Fig. 18 with Fig. 21). Finally the long thin branches forming the "arms" of the acanthocytes sometimes branch. These secondary branches generally do not develop beyond a short projection and are eventually covered by the crystalline deposition. This results in the formation of short channels in the crystalline layer (Figs. 13, 17, 19).

These cells are found on both dicaryotic and monocaryotic cultures. All 39 monocaryons from two collections of S. rugosoannulata (DF2777, DF2778) formed acanthocytes. Preliminary work utilizing energy dispersive X-ray analysis in conjunction with SEM indicates that the crystalline material is composed primarily of calcium.

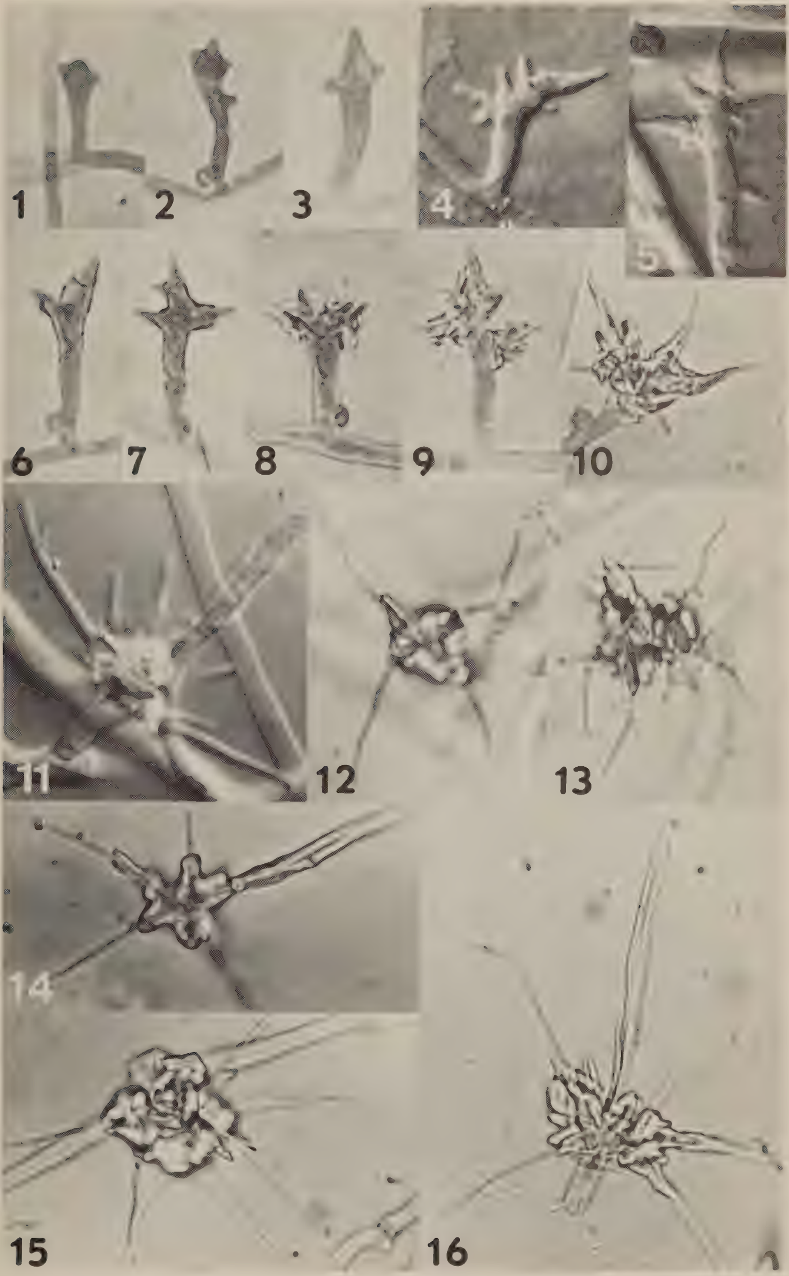
ACANTHOCYTES IN HERBARIUM SPECIMENS

Upon encountering acanthocytes in culture I naturally became interested in which species they might be found. The occurrence of acanthocytes on vegetative mycelia in cultures suggested their possible presence on the vegetative mycelium in the natural substrate. Although herbarium specimens frequently contain large amounts of substrate, fossicking around in the substrate

Figs. 1-16. Stages in the development of acanthocytes. Figs. 1-5. Early stages showing the short lateral branch and the initial apical branching. (1-3. Stained in phloxine, X 1000; 4-5. not stained, photographed with interference contrast optics, X 1200.) Figs. 6-10. Initial deposition of crystalline material, stained in phloxine, X 1000. Figs. 11-16. Elongation of the apical branches. Note short side branches in Fig. 13 and thin layer of crystalline material deposited on longest arm in Fig. 16. (12-16. stained in phloxine; 11. interference contrast; 11-12. X 1400; 13-16. X 1000).

Figs. 17-21. Mature acanthocytes from agar cultures. Fig. 17. The lower arm shows the small channels which result from the formation of small secondary branches as in Fig. 13; X 1100. Fig. 18. The branches have an acute tip and are easily broken from the main body; X 1300. Fig. 19. An acanthocyte with only two branches and a reduced amount of crystalline deposition over the apex of the lateral branch; X 1000. Fig. 20. A side view of a typical acanthocyte; X 1000. Fig. 21. A mature acanthocyte with well developed arms but lacking the heavy deposit of crystals seen in Fig. 18.

Figs. 22-27. SEM photographs of various stages of acanthocyte formation in agar culture. Figs. 22-23. Early stages before elongation of the branches. (22. X 4600; 23. X 3700.) Fig. 24. Mature acanthocyte with discrete crystals over the apex. Figs. 25-26. Uneven deposition of crystalline material along elongating branches. (25. X 4800; 26. X 2200.) Fig. 27. Early stage of development with a more or less even distribution of crystalline material over the surface; X 4600.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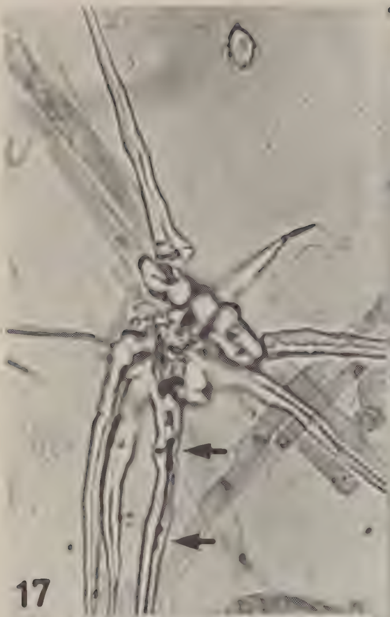
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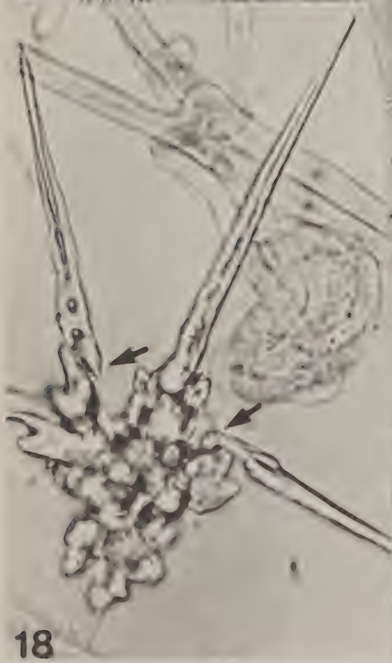
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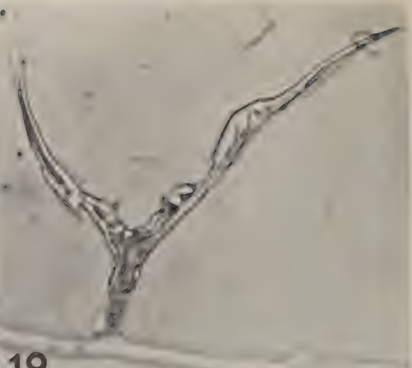
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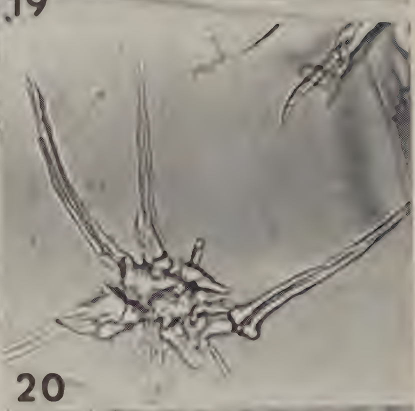
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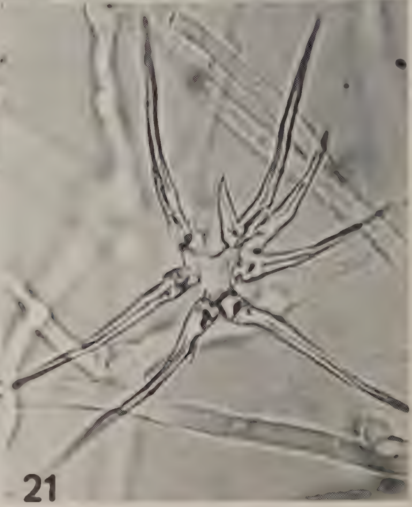
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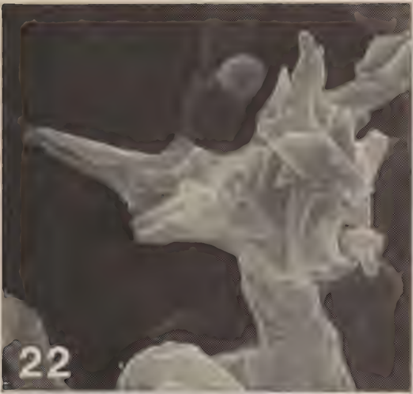
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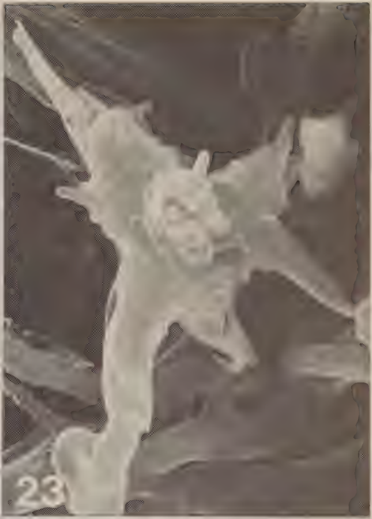
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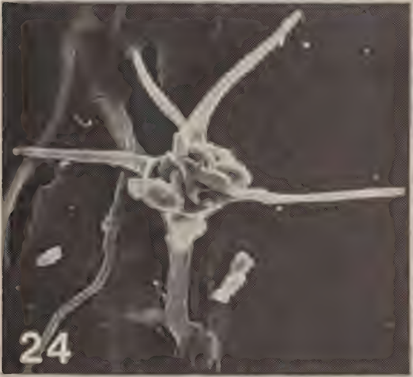
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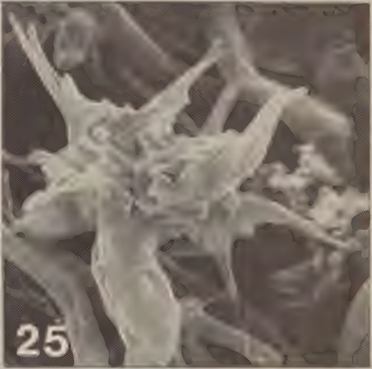
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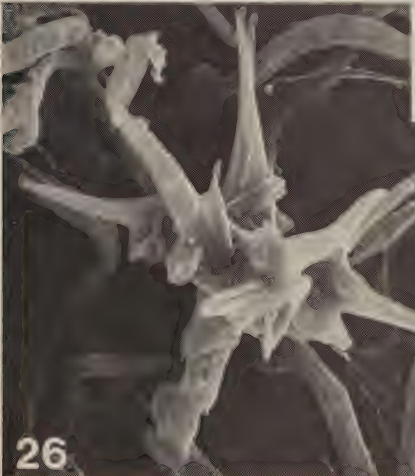
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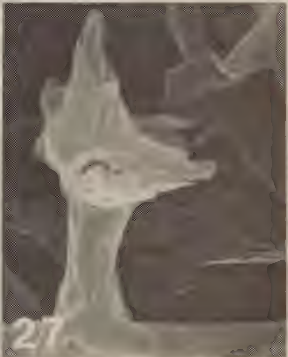
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would be difficult and contamination from the mycelium of other fungi could be a problem. However, the base of the stipe was a potential site for locating acanthocytes because the vegetative mycelium associated with the basidiocarp could be distinguished with certainty. Subsequent examination of stipe bases of herbarium specimens revealed acanthocytes on the vegetative mycelium. The appearance of the acanthocytes in herbarium specimens is similar to those on mycelium in culture. They ranged in size from 20-140 μm with most falling in the range of 50-100 μm.

Some general comments are necessary concerning the location and determination of the presence of acanthocytes. They are almost exclusively located on the vegetative mycelium. Thus, to observe them, examination of a small amount of substrate is generally required. This may seem to be a deterrent to locating these structures in herbarium specimens. However, I have found very few specimens that lacked adequate amounts of substrate to make a reliable determination. While a positive determination depends on the use of a compound microscope, acanthocytes can with experience be observed directly on the herbarium specimen with a dissecting microscope.

Acanthocytes are only infrequently encountered on hyphae of the basidiocarp. In one basidiocarp of *S. rugosoannulata* I found a few scattered acanthocytes on gill tissue. A similar situation in *Stropharia* sp. has been reported by A. H. Smith (pers. comm.). The base of the stipe occasionally produces acanthocytes but generally there is a sharp demarcation between the acanthocyte producing vegetative cells and the compact tissue of the stipe which lacks acanthocytes.

The use of herbarium specimens for a survey of this type is fraught with a significant difficulty. Primarily the problem is one of having to depend upon the identifications provided by various mycologists who may have not had a sufficient understanding of the species involved. Because of this, reliable statements regarding the occurrence of acanthocytes can be made for only those species that are easily recognized and whose species concepts have not undergone extensive revision over the years. Those species whose identifications are reasonably certain and which have been found to produce acanthocytes are *Stropharia aeruginosa* (W. Curtis ex Fr.) Quél., *S. ambigua* (Pk.) Zeller, *S. coronilla* (Bull. ex Fr.) Quél., *S. cyanea* (Bolt. ex Secr.) Tuomikoski, *S. hardii* Atk., *S.*

hornemannii (Fr. ex Fr.) Lundell & Nannf., *S. kauffmanii* A. H. Sm., S. *rugosoannulata* Farlow, *S. subsquamulosa* A. H. Sm. & Mitchell.

How often are these cells found in a particular species? All 28 collections of *S. rugosoannulata* from several localities in the U.S. were found to produce acanthocytes. Similarly all 94 collections examined of *S. ambigua* from the western U.S. and Canada had acanthocytes. All collections examined of the other species listed above were found to have acanthocytes if a sufficient amount of substrate was present. The consistent occurrence of these structures in a given species suggests they have taxonomic value. The question of whether the character is important at the generic, subgeneric or specific level is currently being investigated. Preliminary studies have shown that acanthocytes are not found in some common species of *Psilocybe* and *Nematoloma*.

SUMMARY

A striking cell type has been observed in *Stropharia* species. This cell, formed as a short branch of the vegetative mycelium, initially develops several short branches at its apex. A thick crystalline deposit is laid down over the surface of the cell giving the cell at maturity a spiny appearance. Therefore these cells have been designated acanthocytes. Acanthocytes are a consistent feature of the vegetative mycelium in herbarium specimens and mycelium of monocaryotic and dikaryotic cultures in the genus *Stropharia*.

MYCOTAXON

Vol. XI, No. 1, pp. 250-254 April-June 1980

CONTRIBUTION TO THE LICHEN FLORA OF URUGUAY XIV. NEW OR ADDITIONAL RECORDS FROM CENTRAL URUGUAY.

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SUMMARY. Thirty-nine lichen species collected in Central Uruguay are enumerated. *Heterodermia flabellata*, *Parmelina muelleri* and *Rinodina homobola* are added to the known flora of Uruguay.

This paper is based on a study of some small collections of lichens gathered in the central region of Uruguay. Although many of the species reported here have been collected from other localities, our scant knowledge of the lichen flora from this region has encouraged the author to publish the results obtained.

Except the samples collected by the author and deposited in his private herbarium, all materials cited here are kept in the Herbarium, Museo Nacional de Historia Natural, Montevideo (MVM).

Acarospora boliviana Magn.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7025. Formerly this species was known from three localities in South Uruguay.

A. lorentzii (Müll.Arg.) Hue.
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on stones, Osorio 7039.

Anthracothecium goniostomum Müll. Arg.
FLORIDA: Río Santa Lucía, Estancia Los Cerros, on bark, Izaguirre (MVM 17.430).

Buellia subisabellina Sahlbr.
FLORES: Hwy. 3, km 164, trunk of *Casuarina* at roadside, Osorio 6338.

Caloplaca cinnabarina (Ach.) Zahlbr.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7018.

FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on stones, Osorio 7036; Arroyo Casupá, on granitic stones, Del Puerto (MVM 17.545).

C. crocea (Kremp.) Haf. & Poelt.
FLORIDA: Arroyo Sauce de Mansavillagr and Hwy. 41, on *Salix*, Osorio 7048.
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on bark, Mones (MVM 17.631).

Candelaria concolor (Dicks.) Stein.
FLORES: Arroyo Grande, Paso del Puerto, on *Celtis tala*, Osorio 3576.
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on *Salix*, Osorio 7043.
TACUAREMBO: Paso de los Toros, on bark, Gortari (MVM 17.307).

C. fibrosa (Fr.) Müll. Arg.
FLORES: Arroyo Grande, Paso del Puerto, on shrubs' branches, Osorio 3578.

Collema glaucophthalmum Nyl. var. *implicatum* (Nyl.) Degel.
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on *Salix*, Osorio 7050.

Diploschistes actinostomus (Pers.) Zahlbr.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7016. This species has been previously reported from the adjacent department of Tacuarembó (Magnusson 1950).

D. ochraceus (Anzi) Stein.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone, Osorio 7017.

Dirinaria applanata (Fée) Awas.
FLORIDA: La Cruz, on bark, Lorier (MVM 17.911).

Haematomma montevidense (Räs.) Follm. & Rud.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7024.

Heterodermia diademata (Tayl.) Awas.
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on bark, Mones (MVM 17.628).

H. flabellata (Fée) Awas.
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on *Salix*, Osorio 7049. New to Uruguay.

Hypotrachyna pluriformis (Nyl.) Hale
FLORIDA: La Cruz, on bark, Lorier (MVM 17.913). In Uruguay this species was previously known in two localities, both in its central region, too. (Hale 1975).

Lecanora fusca Müll. Arg.
FLORIDA: Arroyo Casupá, on granitic stones, Del Puerto (MVM

17.544); Arroyo Sauce de Mansavillagra and Hwy. 41, on stones, Osorio 7032.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7023.

Lecidea oreinodes (Koerb.) Web. & Hertel
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7021.a. In Uruguay this species was only known from the department of Montevideo from material collected in the last century (Müller Arg. 1888, as Lecidea angolensis).

L. russula Ach.
DURAZNO: La Paloma-Est. Km 319 Road, 18 km N from La Paloma, on sandstone at roadside, Osorio 7020.
FLORIDA: Arroyo Casupá, on granitic stones, Del Puerto (MVM 17.550).

Leptogium austroamericanum (Malme) Dodge.
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on bark, Mones (MVM 17.632).

Ochrolechia subpallescens Vers.
FLORES: Hwy. 3, km 164, on Casuarina at roadside, Osorio 6340.

Parmelia canaliculata Lynge.
FLORES: Arroyo Grande, Paso del Puerto, on Celtis tala, Osorio 3573.
FLORIDA: Río Santa Lucía, Estancia Los Cerros, on bark, Izaguirre (MVM 17.428).

Parmelina lindamanii (Lynge) Hale
TACUAREMBO: Tambores, Pozo Hondo, on bark, San Martín (MVM 17.400).

P. muelleri (Vain.) Hale
TACUAREMBO: Tambores, Pozo Hondo, on bark, San Martín (MVM 17.401). New to Uruguay. The present discovery extends significatively its distribution in South America. Until this report Tucumán in Argentina (Hale 1976) and Guarapuava in the Brazilian state of Paraná (Osorio 1977), were the most southern collections known.

P. pilosa (Stizb.) Hale
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, on Salix, Osorio 7044.
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on trees, Mones (MVM 17.629).

Parmotrema eciliatum (Nyl.) Hale
TACUAREMBO: Tambores, Pozo Hondo, on bark, San Martín (MVM 17.399). It was cited before for the department of Montevideo (Müller Arg. 1888) and San José (Osorio 1979), both in South Uruguay.

P. reticulatum (Tayl.) Choisy.
FLORIDA: La Cruz, on bark, Lorier (MVM 17.912).

Phaeographina arechavaletae Müll. Arg.
FLORES: Arroyo Grande, Paso del Puerto, on shrubs' branches, Osorio 3579.

Physciopsis syncolla (Tuck.) Poelt.
FLORES: Arroyo Grande, Paso del Puerto, on bark, Osorio 3574.

Pseudoparmelia exornata (Zahlbr.) Hale
RIO NEGRO: Río Negro, Palmar de Mujica, on bark, Boretto (MVM 17.916).

Ps. papillosa (Lynge ex Gyeln.) Hale
FLORIDA: Arroyo Casupá, on granitic stones, Del Puerto (MVM 17.548).

Pyxine subcinerea Stirt.
FLORIDA: La Cruz, on bark, Lorier (MVM 17.910).

Ramalina celastri (Spreng.) Krog & Swinsc.
FLORES: Hwy. 3, km 164, trunk of Casuarina at roadside, Osorio 6336.
FLORIDA: Arroyo Sauce de Mansavillagra and Hwy. 41, wooden fence post at roadside, Osorio 7040; Río Santa Lucía, Estancia Los Cerros, on bark, Izaguirre (MVM 17.429); La Cruz, on bark, Lorier (MVM 17.914).
RIO NEGRO: Río Negro, Palmar de Mujica, on shrubs, Boretto (MVM 17.917).
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on trees, Mones (MVM 17.630).

R. prolifera Tayl.
FLORIDA: Río Santa Lucía, Estancia Los Cerros, on shrubs, Izaguirre (MVM 17.432).

Rinodina homobola (Nyl.) Vain.
FLORES: Arroyo Grande, Paso del Puerto, on wooden fence post, Osorio 3577. New to Uruguay.

Teloschistes chrysophthalmus (L.) Th. Fr. var. *cinereus* Müll. Arg.
FLORES: Arroyo Grande, Paso del Puerto, on *Celtis tala*, Osorio 3575; Hwy. 3, km 164, on *Casuarina* at roadside, Osorio 6339.
FLORIDA: La Cruz, on bark, Lorier (MVM 17.915).

T. cymbalifer (Mey. & Flot.) Müll. Arg.
FLORIDA: Río Santa Lucía, Estancia Los Cerros, on shrubs, Izaguirre (MVM 17.431).

T. exilis (Michx.) Vain.
TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on trees, Mones (MVM 17.627).

Usnea dichroa Mot. var. spinulosa Mot.

FLORES: Hwy. 3, km 164, on wooden fence post at roadside, Osorio 6344.

RIO NEGRO: Río Negro, Palmar de Mujica, on shrubs, Boretto (MVM 17.918).

TACUAREMBO: Arroyo Malo, Once Cerros, 20 km SE from Curtina, on trees, Mones (MVM 17.624); Tambores, Pozo Hondo, on bark, San Martín (MVM 17.402). This species has been cited recently from two localities in SW Uruguay (Osorio 1979 & 1980). With the new localities cited here this species would seem to be widely distributed in the whole country.

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SYNONYMIE DE
ENTOMOPHTHORA VIRULENTA HALL ET DUNN
ET DE
CONIDIOBOLUS THROMBOIDES DRECHSLER

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ABSTRACT

Morphological characters (measurements of primary conidia and zygospores, number of nuclei per conidium), biochemical characters (composition of fatty acids of neutral and polar lipids, electrophoretic patterns of isoenzymes) and pathogenic characters (virulence against Aphids) were used to compare *Entomophthora virulenta* HALL & DUNN and *Conidiobolus thromboides* DRECHSLER. The similarities between the two species are sufficient to demonstrate their synonymy.

INTRODUCTION

Décrite par HALL & DUNN en 1957 comme pathogène de l'Homoptère *Therioaphis trifolii* MON. (= *T. maculata* BUCKT.) *Entomophthora virulenta* est ainsi caractérisée:

"Conidies sphériques à pyriformes avec une papille basale, une paroi mince et un cytoplasme granuleux; longueur (base comprise) 20-32 μ, moyenne 26 μ; largeur 16-28 μ; moyenne 22 μ. Conidies secondaires similaires aux primaires. Conidiophores simples, formant une couverture légèrement brune à rougeâtre sur tout le corps de l'insecte. Corps hyphaux, courtes sections d'un hyphe, de forme irrégulière, souvent branchés ou tordus; 8-12 μ de largeur, 30-60 μ (ou plus) de longueur. Cystides rarement rencontrées. Spores durables généralement azygospores (quelques zygospores observées), sphériques (quelques unes irrégulières) avec une épispore épaisse, lisse et une à plusieurs vacuoles ou globules lipidiques volumineux dans un cytoplasme granuleux; diamètre 15-31 μ, moyenne

22 µ; pas de chlamydospores ou spores interstitielles.Hôte attaché au substrat par des rhizoïdes".

Depuis 1957, de nombreuses souches de *E. virulenta* ont pu être isolées dans différents pays à partir d'Homoptères, de Diptères ou de Lépidoptères (GUSTAFSSON, 1965;SOPER & BRYAN, 1974;HARTMANN & WASTI, 1976;REMAUDIERE et al., 1976). L'étude de ces souches a montré que la description de HALL & DUNN est entachée de 2 erreurs:

- les insectes tués par *E. virulenta* ne sont jamais attachés à la plante par des rhizoïdes (HUMBER et al., 1977)
- les spores durables de *E. virulenta* sont toujours des zygospores. GUSTAFSSON (1965) a déjà signalé la présence de zygospores chez *E. virulenta* mais le même auteur signalait aussi l'existence de rhizoïdes sur les cadavres.

La formation exclusive de zygospores en tant que spores durables de *E. virulenta* a été confirmée par LATGE (1976). Cette étude a montré qu'il est difficile de discerner la nature des spores durables jeunes (surtout si elles sont formées sur le même hyphe) et peut expliquer l'interprétation de HALL & DUNN (1957) qui signalent la présence de quelques zygospores parmi une majorité d'azygospores.

E. virulenta, ainsi nouvellement défini, possède les 3 caractéristiques du genre *Conidiobolus* récemment révisé par KING (1976a,b): (1) existence de conidies primaires sphériques plurinucléées;(2) présence de zygospores;(3) croissance facile de type saprophytique. Cet auteur a d'ailleurs suggéré que plusieurs espèces d'*Entomophthora*, notamment *E. virulenta*, devraient être replacées à l'intérieur du genre *Conidiobolus*. GUSTAFSSON (1965) avait déjà noté que le mode de formation des zygospores de *E. virulenta* était similaire à celui d'espèces du genre *Conidiobolus*;cet auteur rapprochait d'ailleurs *E. virulenta* de *C. brefeldianus*. En réalité, *C. brefeldianus* se différencie très facilement de *E. virulenta* par son aptitude à produire des microconidies (COUCH, 1939;KING, 1976b). L'espèce de *Conidiobolus* dont la morphologie est la plus proche de *E. virulenta* semble *C. thromboides* (KING, 1976b;LATGE, 1976).

La mise en synonymie de 2 espèces d'Entomophthorales, notamment du genre *Conidiobolus*, sur les seules bases morphologiques est souvent difficile. Ainsi, une révision taxonomique récente de *Entomophthora obscura* HALL & DUNN (REMAUDIERE et al., 1979) montre qu'une extrême variabilité est constatée dans les mensurations des conidies et des azygospores de cette espèce. Des caractères biochimiques et pathologiques ont alors efficacement complété la définition de l'espèce fongique considérée.

TYRRELL (1967) a le premier suggéré l'utilisation des profils d'acides gras des lipides totaux en vue de la différenciation des espèces d'Entomophthorales entre elles. L'étude des profils d'acides gras des lipides polaires et des lipides neutres s'est récemment révélée plus précise que celle des seuls lipides totaux (LATGE & DE BIEVRE, 1980). Par ailleurs, la considération des profils électrophorétiques d'isoenzymes tels que ceux de la leucine aminopeptidase, de la tetrazolium oxydase et de la phosphatase alcaline a permis une différenciation de certaines espèces du genre *Conidiobolus* en accord avec la séparation obtenue d'après les données morphologiques (KING, 1976c). Ainsi les deux critères biochimiques utilisables à ce jour dans l'étude taxonomique des Entomophthorales, sont la composition en acides gras des lipides polaires et neutres du champignon et les profils électrophorétiques d'isoenzymes. Le nombre de noyaux des conidies primaires (BATKO, 1964) et les exigences nutritionnelles (LATGE, 1975a,b;KING, 1976) peuvent être aussi utilisés dans la caractérisation des espèces d'Entomophthorales. La considération de certains éléments se rapportant à la pathogénie de la mycose et au développement du champignon dans l'hôte peut être également utile à la caractérisation d'une espèce d'Entomophthorales. Ainsi, la présence éventuelle et la forme des rhizoïdes attachant l'insecte au substrat ont été considérées depuis longtemps comme un critère taxonomique important chez les Entomophthorales (GUSTAFSSON, 1965). La recherche de cystides sur le cadavre, la mesure de la durée d'incubation de la maladie et de l'intensité de la sporulation ont pu mettre en évidence la variabilité existant à l'intérieur d'une espèce telle que *E. obscura* (REMAUDIERE et al., 1979;PAPIEROK & WILDING, 1980).

Ces résultats nous ont amenés à étudier l'éventuelle identité spécifique de *E. virulenta* et de *C. thromboides* en considérant non seulement les données morphologiques mais aussi des caractères biochimiques et pathologiques.

MATERIEL ET METHODES

I. Souches

Les références des souches utilisées sont précisées dans le tableau I. Il n'a pas été retrouvé d'exsiccata type de *E. virulenta* et de *C. thromboides*. Les souches types de *E. virulenta* et de *C. thromboides* ont respectivement les références ATCC 14270 et ATCC 12587. Nous désignons comme lectotype de *E. virulenta* les figures 12 et 14 de la description originale de HALL & DUNN (1957). La figure 2 de la description originale de DRECHSLER (1953) a été déjà désignée comme lectotype de *C. thromboides* par KING (1977);des exsiccata de culture de la souche type de *C. thromboides* ATCC 12587 contenant des conidies et des zygospores sont désignés comme néotypes de cette espèce et sont déposés à l'herbier du laboratoire de Cryptogamie du Muséum d'Histoire naturelle de Paris (PC).

TABLEAU I. Références d'isolement.

SOUCHES	SOURCE	PAYS	AUTEURS
E.VIRULENTA (ATCC 14270) = CBS 18360	Insecte: *Therioaphis trifolii*	Etats-Unis	HALL & DUNN (1957)
E.VIRULENTA (ATCC 36931)	Insecte: *Myzus persicae*	Etats-Unis	SOPER & BRYAN (1974)
C.THROMBOIDES (ATCC 12587) = CBS 15956	Feuille moisie	Etats-Unis	DRECHSLER (1953)
C.THROMBOIDES (ATCC 32194)	Champignon: *Craterellus cornucopioides*	Etats-Unis	KING,LAHN & JONG (1976)
C.STROMOIDEUS (ATCC 15430)	Insecte: associé à *E.muscae*	Inde	SRINIVASAN & THIRUMALACHAR (1962)
C.OSMODES (ATCC 38865)	Sol	France	COREMANS-PELSENEER (1977)

II. Observations

1. Conidies et zygospores

a. Mesures

Les conidies produites en boîtes de Petri à 21°C sur milieu PDA (2 % glucose) ATCC 336 sont montées sur lame dans l'eau. Pour chaque souche, 20 conidies sont mesurées. Les zygospores sont produites sur le même milieu PDA à 21°C à l'obscurité. Pour chaque souche, trois boîtes de Pétri sont ensemencées et 18 spores mesurées par boîte. Les spores sont mesurées dans le mélange bleu coton-lactophénol.

b. Nombre de noyaux

Les noyaux des conidies primaires sont colorés à l'hématoxyline ferrique d'après la méthode de LU (1967). Leur nombre est compté sur 20 conidies pour chaque souche.

c. Microscopie électronique

Les zygospores pour examen au microscope électronique à balayage sont produites sur un milieu gélosé à base de glucose (4 %) et d'extrait de levure (1 %). Elles sont deshydratées et soumises à la fixation au point critique avant métallisation à l'or-palladium. L'évolution de la morphologie des zygospores de *E. virulenta* au cours de leur vieillissement a été aussi suivie en culture liquide.

2. Croissance

La croissance des souches de *E. virulenta* et *C. thromboides* est notée sur un milieu PDA après 3 jours de croissance à 21°C à l'obscurité. L'inoculum est un cercle de 4 mm de diamètre.

3. Composition en acides gras des lipides neutres et polaires

Les souches sont cultivées pendant 24 h dans un milieu contenant 4 % de glucose, 1 % d'extrait de levure (DIFCO) et 1 % d'Antimousse Rhodorsil 426 R en fermenteur BIOLAFITTE de 2 litres (20°C, 700 tours par min., 30 l air/h). Le mycélium est récupéré par filtration, lavé 3 fois à l'eau distillée et stocké au congélateur. Les lipides neutres et lipides polaires des différentes souches sont extraits par le chloroforme et le méthanol, puis hydrolysés. Les esters méthyliques des acides gras ainsi libérés sont analysés par chromatographie en phase gazeuse et leur concentration est exprimée en % (LATGE & DE BIEVRE, 1980).

Les lipides neutres et polaires de *C. stromoideus* (espèce morphologiquement voisine de *C. thromboides*) et ceux de *C. osmodes* (espèce souvent isolée de pucerons mais morphologiquement différente de *C. thromboides* et de *C. stromoideus*) ont été aussi analysés. Ces 2 espèces sont comparées à *C. thromboides* et à *E. virulenta* du seul point de vue composition en acides gras.

4. Profils électrophorétiques

Les deux systèmes enzymatiques utilisés, l'alcool deshydrogénase (E.C. 1.1.1.1) et la leucine aminopeptidase (E.C. 3.4.11.1) sont étudiés d'après une modification de la technique de SHAW & PRASAD (1970). Chaque souche est cultivée dans 2 tubes de milieu gélosé ATCC 1005 (glucose 2 %, extrait de levure 0,5 %, peptone 1 %) pendant 4 jours; le mycélium total est récupéré et transféré dans une fiole d'Erlenmeyer de 250 ml avec 100 ml de milieu liquide ATCC 1005. Après 4 jours d'agitation à 200 tpm à 20°C, le mycélium est filtré, puis agité en tube pendant 7 minutes avec 10 g de billes de verre de 1 mm. L'homogénisat est absorbé sur papier filtre et soumis à une électrophorèse sur gel d'amidon à 13 % sous 250 V. Le tampon du gel contient 5,5 mM d'acide citrique associé à 8,8 mM de Tris Base (Sigma). Le tampon du réservoir est du borate de sodium 0,297 M. Les bandes des isoenzymes sont repérées par leur Rf.

5. Infection expérimentale de pucerons

L'action pathogène de la souche ATCC 36931 de *E. virulenta* et de la souche ATCC 12587 de *C. thromboides* a été recherchée vis-à-vis de l'Aphide *Acyrthosiphon pisum* HARRIS. La méthode d'estimation du pouvoir pathogène à l'égard des adultes ailés de cette espèce a été décrite récemment (PAPIEROK & WILDING, 1979); 4 fois 5 lots de 10 pucerons sont exposés au flux des conidies émises par des cultures durant respectivement 5,20,80 et 320 mn.

RESULTATS ET DISCUSSION

I. Observations morphologiques

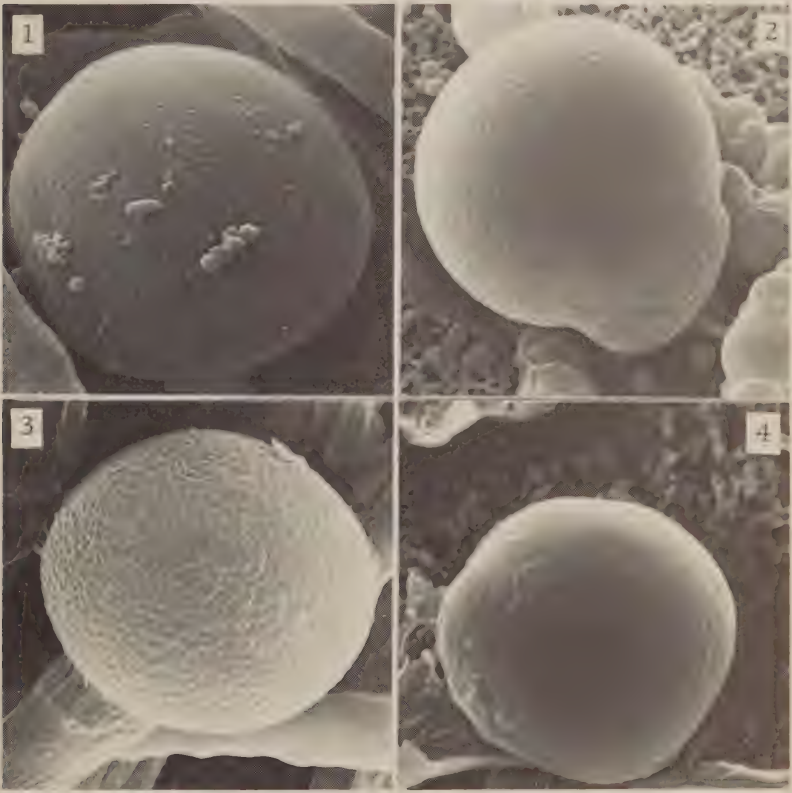
Il n'existe pas de différence entre les moyennes des diamètres des spores et conidies de *E. virulenta* et de *C. thromboides*. Les mesures effectuées sur les 4 souches en culture sont identiques aux mensurations données dans les descriptions originales de HALL & DUNN et de DRECHSLER (Tableau 2). Les conidies secondaires sont de forme simi-

TABLEAU 2. Mesures en µm des conidies primaires et des zygospores de *Entomophthora virulenta* et de *Conidiobolus thromboides* selon les descriptions originales et à partir des souches de mycothèque.

SOUCHES	CONIDIES PRIMAIRES	
E. VIRULENTA	Diamètre	Longueur
desc.orig.	16(22)28(a)	20(26)32
ATCC 14270	20(24)30	24(28)35
ATCC 36931	21(23)25	26(28)30
C. THROMBOIDES		
desc.orig.	19(?)27	24(?)32
ATCC 12587	21(25)28	24(30)34
ATCC 32194	18(23)25	22(27)31

	ZYGOSPORES			
	Spore jeune		Spore mûre	
E. VIRULENTA	Diamètre	Paroi	Diamètre	Paroi
desc.orig.	?	?	15(22)31	?
ATCC 14270	24(27)32	0,6(1,2)2,2	20(24)31	3,3(4,1)5,5
ATCC 36931	22(25)30	0,6(1,9)4,4	15(24)28	3,3(4,6)6,1
C. THROMBOIDES				
desc.orig.	?	?	18(?)24	2,0(?)2,5
ATCC 12587	25(28)33	0,6(1,9)3,9	21(26)29	2,2(4,4)5,5
ATCC 32194	24(27)34	0,6(2,1)4,4	22(25)29	3,3(4,4)5,5

(a) les valeurs extrêmes des mensurations entourent la moyenne mentionnée entre parenthèses laire aux conidies primaires. Les conidies primaires des 4 souches contiennent un nombre de noyaux identique compris entre 22 et 30 noyaux par conidie (26 en moyenne). Au microscope électronique à balayage, les zygospores de *E. virulenta* et de *C. thromboides* présentent la même fine ornementation. Celle-ci peut d'ailleurs légèrement varier en fonction des spores observées;cependant, la hauteur des crêtes reste toujours inférieure à 0,25 µm (Figs 1,2,3).



FIGS 1,2,3. Types d'ornementation observés indifféremment chez les zygospores de *E. virulenta* (souches ATCC 14270 et ATCC 36931) ou de *C. thromboides* (souches ATCC 12587 et ATCC 32194) produites en milieu solide. FIG. 4. Zygospore de *E. virulenta* (ATCC 36931), 10 jours après sa formation en milieu liquide.

La considération de l'âge des zygospores est très importante. Le diamètre des spores jeunes sans paroi épaisse est toujours plus grand que celui des spores mûres (Tableau 2). Par ailleurs, on remarque au microscope électronique à balayage que l'ornementation des zygospores s'estompe au cours du vieillissement de la zygospore dans le milieu liquide (Fig. 4).

Après 3 jours de culture, la croissance atteint 39 mm pour les 2 souches de *E. virulenta* et 49 et 46 mm respectivement pour les souches ATCC 12587 et 32194 de *C. thromboides*. La différence de vitesse de croissance entre les 2 souches n'est pas suffisante pour représenter une distinction interspécifique. En effet, des différences beaucoup plus grandes ont été notées au laboratoire entre les vitesses de croissance de souches appartenant à une même espèce telle *E. aphidis*, *E. obscura*, *E. sphaerosperma* ou *E. phalloides*.

II. Observations biochimiques

Les profils d'acides gras des lipides neutres de *C. thromboides* et *E. virulenta* sont identiques (Tableau 3).

TABLEAU 3. Composition en acides gras des lipides neutres de *Entomophthora virulenta*, *Conidiobolus thromboides*, *C. osmodes* et *C. stromoideus* (a).

	E.VIRULENTA		*C.THROMBOIDES*		*C.OSMODES*	*C.STROMOIDEUS*
	14270	36931	12587	32194	38865	15430
C12:0	-	-	-	-	6,9	-
C13:0	-	-	-	-	-	tr(b)
C14:0	10,2	9,3	9,3	7,6	12,3	10,7
C15:0 C14:1	0,6	1,2	tr	0,8	tr	tr
C16:0	13,4	9,5	14,8	13,1	8,9	23,7
C16:1	22,2	22,9	22,4	19,4	8,2	12,6
C iso 17	0,7	1,1	0,6	0,7	-	-
C17:0	1,4	0,8	1,2	1,6	2,3	-
C18:0	1,6	1,4	1,8	2,0	2,4	8,9
C18:1	40,3	43,6	31,8	40,8	40,5	44,2
C18:2	1,1	2,8	1,9	1,3	1,8	tr
C18:3	tr	0,6	1,1	1,3	1,3	tr
X1	tr	tr	tr	tr	-	-
X2	1,3	0,6	1,1	tr	0,9	tr
C20:3	1,1	1,9	2,8	1,8	1,3	tr
C20:4	6,1	4,1	10,8	9,2	12,9	tr

(a) le numéro des souches est le numéro de collection ATCC
(b) tr:concentration inférieure à 0,5 %

Ils sont caractérisés par l'absence d'acides en C12:0 et C13:0, la présence en faible concentration de C17:0 et de C iso 17 et la forte teneur de C14:0, C16:0, C16:1, C18:1 et C20:4. Le rapport des teneurs C16:0/C16:1 est toujours inférieur à 1. *C. osmodes* se différencie facilement de ces souches par la présence d'une forte teneur en C12:0, l'absence de C iso 17 et des teneurs relativement faibles en C16:0 et C16:1. A la différence de *C. thromboides* et de *E. virulenta*, *C. stromoideus* contient peu de C20:4 et ne renferme pas de C17:0 ni de C iso 17. Par ailleurs, le rapport des concentrations de C16:0/C16:1 est toujours supérieur à 1.

Les profils d'acides gras des lipides polaires ressemblent à ceux des lipides neutres (Tableau 4). *C. thromboides* et *E. virulenta* ont encore des profils d'acides gras similaires avec de fortes concentrations en C16:0, C16:1, C18:1 et C20:4 (et un rapport C16:0/C16:1 inférieur à 1). Les lipides polaires de *C. osmodes* ne contiennent pas de C iso 17, ni de C18:0; cette espèce est riche en C20:4; le rapport C16:0/C16:1 est supérieur à 1. De même, les lipides polaires

TABLEAU 4. Composition en acides gras des lipides polaires de *Entomophthora virulenta*, *Conidiobolus thromboides*, *C. osmodes* et *C. stromoideus* (a).

	E.VIRULENTA		*C.THROMBOIDES*		*C.OSMODES*	*C.STROMOIDEUS*
	14270	36931	12587	32194	38865	15430
C12:0	-	tr(b)	-	tr	tr	-
C13:0	-	-	-	-	-	tr
C14:0	8,7	5,0	5,8	6,6	6,9	2,2
C15:0 C14:1	0,6	tr	tr	0,7	1,5	tr
C16:0	15,1	10,5	13,5	13,3	7,1	14,4
C16:1	19,3	14,7	18,8	17,7	4,3	11,8
C iso 17	1,8	1,5	1,4	0,9	-	-
C17:0	2,3	0,7	3,1	2,5	0,7?	-
C18:0	0,9	1,3	0,8	1,0	-	1,3
C18:1	29,3	29,1	27,7	34,6	27,4	47,6
C18:2	1,3	4,0	2,0	1,6	4,5	2,4
C18:3	1,4	2,2	3,1	2,4	3,6	-
X1	0,8	0,8	tr	tr	-	-
X2	1,7	1,2	tr	tr	-	-
C20:3	1,0	1,7	2,9	1,8	2,0	4,5
C20:4	15,8	26,6	20,7	16,1	41,4	14,9

(a) le numéro des souches est le numéro de collection ATCC
(b) tr:concentration inférieure à 0,5 %

de *C. stromoideus* ne contiennent toujours pas de C17:0 et C iso 17 mais possèdent de fortes teneurs en C18:1 et un rapport C16:0/C16:1 supérieur à 1.

D'après les phénogrammes de KING (1976b), les 3 espèces de *Conidiobolus* morphologiquement voisines de *E. virulenta* sont *C. thromboides*, *C. stromoideus* et *C. megalotocus*. TYRRELL (1967, 1971) et TYRRELL & WEATHERSTON (1976) ont montré que la composition en acides gras de *C. megalotocus* est caractéristique des espèces à microconidies; bien que ne produisant pas de microconidies en culture, *C. megalotocus* a donc été regroupé avec des espèces telles que *C. brefeldianus* ou *C. coronatus* (KING, 1976b); cette espèce n'est donc pas considérée ici. Les présentes analyses d'acides gras des lipides neutres et polaires de *E. virulenta*, *C. thromboides* et *C. stromoideus* montrent que la composition des 2 premières espèces est similaire et différente de celle de *C. stromoideus*. Ce résultat rejoint les analyses de TYRRELL (1967) qui, sans avoir fait le rapprochement entre les deux espèces *E. virulenta* et *C. thromboides*, a cependant noté des compositions en acides gras des lipides totaux identiques pour les deux espèces.

Le tableau 5 montre les profils électrophorétiques des 2 enzymes testées chez les 4 souches de *C. thromboides* et *E. virulenta*. Bien que les résultats de l'alcool deshydrogénase soient variables, la considération de ces profils enzymatiques atteste l'existence de liens étroits entre ces 2 espèces.

TABLEAU 5. R_f de la leucine aminopeptidase et de l'alcool deshydrogénase de *Entomophthora virulenta* et de *Conidiobolus thromboides*.

SOUCHES	LEUCINE AMINOPEPTIDASE	ALCOOL DESHYDROGENASE
E. VIRULENTA		
ATCC 14270	0,85	0,86 0,83 0,74 0,67
ATCC 36931	0,85	-
C. THROMBOIDES		
ATCC 12587	0,85	0,86 0,83
ATCC 32194	0,85	-

III. Observations pathologiques

Les individus de *Acyrthosiphon pisum* sont également sensibles à *E. virulenta* et à *C. thromboides* (Tableau 6). Les concentrations létales 50 (CL 50) de *E. virulenta* (21,4 conidies/mm^2) et de *C. thromboides* (15,5 conidies/mm^2) sont du même ordre de grandeur. Dans les deux cas, la mortalité débute dès la fin du séjour des pucerons en atmosphère saturée, c'est-à-dire 29h 20' après le début de l'exposition aux conidies. Le développement du champignon a lieu post-mortem, il est limité à la tête et au thorax, l'abdomen prenant un aspect ratatiné. La présence de toxine a été démontrée chez *E. virulenta* (CLAYDON, 1978; CLAYDON & GROVE, 1978);un tel comportement in vivo du champignon est certainement dépendant de l'action de ces toxines. Il n'existe pas de rhizoïdes attachant les pucerons à la plante-hôte, ni de cystides sur les cadavres sporulant, contrairement à ce qu'affirment HALL & DUNN dans la description originale.

Ces résultats corroborent les observations de REMAUDIERE et al. (1976) qui ont récemment remis en question la pathogénicité de *E. virulenta*. En effet, la rareté de son isolement dans la nature (une dizaine de fois en une dizaine d'années de prospection), le manque de spécificité (*E. virulenta* a été isolé d'Homoptères, Diptères et Lépidoptères) et le faible envahissement mycélien du cadavre (alors que *E. virulenta* ne présente aucune exigence nutritionnelle particulière) laissent supposer que *E. virulenta* a une existence saprophytique du type *Conidiobolus* avec un comportement pathogène occasionnel ou opportuniste.

TABLEAU 6. Concentration létale 50 (CL 50) d'une souche de *Entomophthora virulenta* et d'une souche de *Conidiobolus thromboides* vis-à-vis de *Acyrthosiphon pisum*.

SOUCHES	CL 50 (a)	LIM.INT.CONF. (b)	χ^2 (c)	D.D.L. (d)	PENTE (e)	E.TYPE (f)
E.VIRULENTA (ATCC 36931)	21,4	16,2-28,5	29,6	18	1,61	0,25
C.THROMBOIDES (ATCC 12587)	15,5	11,3-19,7	25,3	18	1,90	0,27

(a) CL 50 exprimée en conidies/mm^2
(b) lim.int.conf.:limites de l'intervalle de confiance avec une probabilité de 95 %
(c) au point 5 %, χ^2 = 28,9 avec 18 degrés de liberté
(d) d.d.l.: degrés de liberté
(e) pente: pente de la droite de regression
(f) e.type: écart-type

CONCLUSION

La morphologie (conidies primaires et zygospores), la croissance, la biochimie (composition en acides gras des lipides neutres et polaires et profils électrophorétiques) et la pathologie de *E. virulenta* et *C. thromboides* sont identiques. Les éléments de ressemblance sont suffisamment nombreux pour affirmer que *E. virulenta* et *C. thromboides* sont conspécifiques. Sur la base de l'examen des souches authentiques dites "type" de ces deux espèces trouvées en parfaite correspondance avec les descriptions originales dont les illustrations sont désignées comme lectotypes, la synonymie de *C. thromboides* s'établit donc comme suit:

Conidiobolus thromboides DRECHSLER 1953
J. Wash. Acad. Sci., *43*, 29-43
= *Entomophthora virulenta* HALL & DUNN 1957 syn. nov.
≡ *Culicicola virulenta* (HALL & DUNN) BATKO 1964

Types de *C. thromboides*:

Lectotype:figure 2 de la description de DRECHSLER (1953) désigné par KING (1977);néotype:exsiccata contenant des conidies et spores provenant de cultures de la souche ATCC 12587 et de la souche ATCC 14270 déposés à l'herbier du Laboratoire de Cryptogamie du Muséum d'Histoire naturelle de Paris (PC).

Comme dans le cas de la reconsidération taxonomique de *Entomophthora obscura* HALL & DUNN (REMAUDIERE et al., 1979), nos résultats confirment l'intérêt de compléter la caractérisation morphologique d'une espèce de *Conidiobolus* ou de *Entomophthora* par une étude biochimique et pathologique. Le présent travail confirme que certaines espèces d'*Entomophthora* appartiennent au genre *Conidiobolus* et montre la nécessité d'une révision taxonomique de ce groupe fongique. Nos résultats montrent que 8 critères peuvent être au moins utilisés dans la taxonomie des Entomophthorales:(1) forme et taille des conidies primaires (2) forme et taille des zygospores (3) forme et taille des conidies secondaires (4) nombre de noyaux des conidies (5) exigences nutritionnelles (6) composition en acides gras des lipides neutres et polaires (7) profils électrophorétiques d'isoenzymes (8) comportement pathogène.

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REVISION SYSTEMATIQUE DE ENTOMOPHTHORA APHIDIS HOFFM. IN FRES. DESCRIPTION DE DEUX NOUVEAUX PATHOGENES D'APHIDES

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ABSTRACT

Originally attributed to an aphid pathogen on *Cornus*, the name *Entomophthora aphidis* Hoffm. in Fres. was erroneously applied to the most common pathogen encountered in aphid populations. The various conidial forms including capilloconidia are fully described from new material collected in the Alps ex *Anoecia* on *Cornus*. The species, designated as *Zoophthora aphidis* (Hoffm. in Fres.) Batko, is closely allied to *Z. radicans* (Bref.) Batko from which it differs mainly by having broader capilloconidia and much larger resting spores.

The subgeneric divisions introduced by Batko in *Zoophthora* Batko are discussed. The application of this genus name is restricted to the species giving capilloconidia. The subgenus *Pandora* established by Batko, with *aphidis* Hoffm. in Fres. as type species, becomes synonymous with *Zoophthora*. The other species classified in the subgenera *Erynia*, *Pandora* and *Furia* are brought together in *Erynia* Nowak. which is re-established to the genus level.

The species *Entomophthora ferruginea* Phill. in Hought. & Phill. and *Entomophthora exitialis* Hall & Dunn are considered as *nomina confusa*.

Erynia neoaphidis sp. nov. is described;"*E. aphidis*" sensu Nowak. or sensu Thaxter is identical to this species.

Erynia nouryi sp. nov. is described;"*E. aphidis*" sensu Petch 1939 and "*E. exitialis*" sensu Gustafsson are identical to this species.

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Dans un récent article, Remaudière et al. (1978) considèrent que trois entités spécifiques sont apparemment confondues sous le même taxon *Entomophthora aphidis* Hoffm. in Fres.:

- *Entomophthora aphidis* Hoffm. in Fres. (1858), espèce à spores durables volumineuses, originellement décrite comme pathogène d'un puceron vivant sur *Cornus sanguinea*,
- *"Entomophthora aphidis"* sensu Nowak. (1883) (= sensu Thaxter 1888), espèce la plus commune dans les populations d'un très grand nombre d'Aphides qui ne forme probablement jamais de spores durables chez les pucerons,
- *"Entomophthora aphidis"* sensu Grobler et al. (1962) à spores durables plus petites que celles de *Entomophthora aphidis* Hoffm. in Fres., espèce seulement connue comme pathogène du puceron *Schizolachnus piniradiatae* Davidson sur *Pinus resinosa*.

L'étude des données historiques fournies par la littérature, celle des syntypes de *Entomophthora aphidis* Hoffm. in Fres. et la redécouverte de l'espèce sous toutes ses formes nous conduisent à en donner une description complète et à montrer que son nom a été appliqué par erreur à plusieurs autres espèces dont nous pouvons maintenant préciser le statut.

1 HISTORIQUE

Dans cette partie, nous rappelons les principaux travaux consacrés à *Entomophthora aphidis* ainsi que ceux traitant de *Entomophthora ferruginea* Phill. in Hought. & Phill. (1886) et de *Entomophthora exitialis* Hall & Dunn (1957), espèces qui ont été comparées à *Entomophthora aphidis* par plusieurs auteurs.

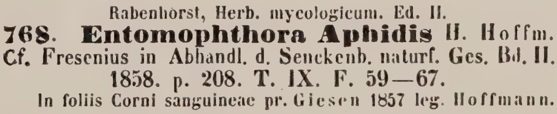
A. DESCRIPTION ORIGINALE ET APPLICATIONS SUCCESSIVES DU NOM *ENTOMOPHTHORA APHIDIS*

a) *LA DESCRIPTION ORIGINALE DE HOFFMANN IN FRESENIUS ET L'EXAMEN DES SYNTYPES*

D'après la description originale de Fresenius (1858), *Entomophthora aphidis* Hoffm. in Fres. a été découvert en automne à Giessen par H. Hoffmann, chez un puceron "vraisemblablement *Aphis corni*" vivant sur les feuilles de *Cornus sanguinea*:

Les petits spécimens aptères de cette espèce d'insecte sont remplis de grosses spores sphériques, tandis qu'un grand ailé présente du mycélium dans la cavité abdominale. Fresenius précise que "le mycélium apparaît pauvrement développé et formé de filaments bruns, courts, branchus, plus ou moins torsadés, qui produisent les spores à leur extrémité ou sur de très courtes ramifications latérales. Ces dernières (les spores durables) demeurent attachées aux filaments résiduels si bien que leur séparation ne réussit pas aussi aisément que chez les autres espèces" (traduit de l'allemand). La dimension des spores varie de 1/30 à 1/23 mm (soit 33,3 à 43,5 µm), le plus souvent 1/27 à 1/25 mm (soit 37 à 40 µm). Les figures originales 61 à 64 (Fig. 1) montrent que les spores sont lisses. La forme conidienne n'est pas mentionnée.

Le matériel authentique récolté par Hoffmann en 1857 se trouve sous le N° 768 dans l'édition II du Rabenhorst: Klotzschii herbarium vivum mycologicum (1858) accompagné de l'étiquette suivante:



Rabenhorst, Herb. mycologicum. Ed. II.
768. Entomophthora Aphidis H. Hoffm.
Cf. Fresenius in Abhandl. d. Senckenb. naturf. Ges. Bd. II.
1858. p. 208. T. IX. F. 59—67.
In foliis Corni sanguineae pr. Giesen 1857 leg. Hoffmann.

Les exsiccata conservés au Muséum de Paris (PC), à l'Institut botanique de Pavie (PAV) et au Royal Botanic Gardens de Kew (K) ont été examinés; ils comportent une feuille de *Cornus sanguinea* avec quelques cadavres de sexués d'*Anoecia* sp. de couleur noire, remplis de spores et parfois des ailés sexupares du même puceron.

Le Royal Botanical Garden d'Edinburgh (E) nous a communiqué un exsiccatum de la collection Siemaszko récolté en Pologne en octobre 1926 sur feuilles de *Cornus sanguinea*: le puceron hôte est également une espèce du genre *Anoecia* et son pathogène est semblable à celui du matériel d'Hoffmann.

Les mensurations des spores extraites de ces échantillons puis montées dans le bleu trypan lactophénol sont données dans le tableau 1.

Les valeurs moyennes obtenues varient de 36,4 à 40,1 µm et concordent parfaitement avec les dimensions les plus fréquentes mentionnées dans la description originale (37 à 40 µm); les valeurs extrêmes (27 à 48 µm) encadrent bien celles publiées par Fresenius (33,3 à 43,5 µm).

L'examen du matériel authentique permet d'apporter les précisions suivantes: les spores durables présentent une épispore brune, amorphe qui se dilacère lorsqu'on veut les séparer, elles apparaissent alors hyalines avec une paroi épaisse et présentent souvent des fragments d'épispore. La difficulté rencontrée par Fresenius pour isoler les spores paraît davantage résulter de la cohésion des épispores que de l'attachement des spores au mycélium résiduel, les hyphes étant peu nombreux dans les cadavres remplis de spores mûres (Fig. 21).

Les exsiccata du Rabenhorst Klotzschii herbarium vivum mycologicum ed. II n. 768 sont des syntypes de l'espèce *Entomophthora aphidis* Hoffm. in Fres. Les syntypes de Pavie et de Kew sont très pauvres (2 pucerons avec spores durables); celui de Paris, qui renferme 5 cadavres pleins de spores, est désigné ici comme lectotype de *Entomophthora aphidis* Hoffm. in Fres.

Le genre *Entomophthora* Fresenius 1856 a été créé explicitement par Fresenius pour remplacer *Empusa* Cohn 1855 qui était préoccupé par *Empusa* Lindney 1824 (*Orchidaceae*); il conserve de ce fait, en tant que *nomen novum*, l'espèce type de *Empusa* Cohn, *Empusa muscae* Cohn, renommée *Entomophthora muscae* (Cohn) Fres. 1856. Toute lectotypification postérieure à 1856 ne confirmant pas *Empusa muscae* Cohn et qui désigne l'une des deux autres espèces originales de *Entomophthora* Fres. 1856, *E. grylli* Fres. 1856 ou *E. sphaerosperma* Fres. 1856 est erronée parce que contraire à l'article 7 du code (code international de nomenclature botanique, Stafleu 1972).

TABLEAU 1

Mesures (en µm) du diamètre des spores durables de *Entomophthora aphidis* sur matériel authentique de l'herbier Rabenhorst (Paris, Pavie et Kew) et sur matériel polonais de Siemaszko (n = nombre de spores mesurées)

ORIGINE	INDIVIDU		n	min	MOY	max
Rabenhorst	I	CP	50	33	40,I	48
	2	CP	50	33	37,6	4I
	3	PAV	7I	30	36,5	44
	4	K	28	3I	37,7	4I
Siemaszko	I	E	50	33	39,9	46
	2	E	50	27	36,4	42
	3	E	50	30	36,7	44

C'est le cas de la typification de von Arx (1970) qui désigne à tort *E. sphaerosperma* Fres. comme espèce type de *Entomophthora* Fres.

En 1858, *Entomophthora* Fres. est l'unique genre valide de la famille des *Entomophthoraceae* Nowak. 1883 (ut *Entomophthoreae*) *Pamietn. Wydz. Akad. Umiej. w. Kraków.* 8: 154 (= *Entomophthoraceae* Warning 1884). En plus des 3 espèces originales, ce genre comprend *Entomophthora aphidis* Fres. ainsi que trois autres espèces: *Entomophthora tenthredinis* Fres., *Entomophthora tipulae* Fres. et *Entomophthora culicis* (A. Braun) Fres.

b) *LA NOUVELLE COMBINAISON DE COHN*

Bien qu'il considère que les conidies et les spores durables représentent deux formes du cycle des champignons qu'il étudie, Cohn (1870) - qui ne reconnaît pas la valeur du genre *Entomophthora* Fresenius - restreint l'application de son genre *Empusa* aux espèces dont on connaît seulement la forme conidienne et crée le genre *Tarichium* pour celles qui ne sont connues que par la forme spores durables, sur la base de *T. megaspermum* Cohn 1870 (espèce type). Dans ce dernier genre, il inclut deux autres espèces pour lesquelles il précise les nouvelles combinaisons suivantes: *Tarichium aphidis* (Hoffm. in Fres.) Cohn et *Tarichium sphaerospermum* (Fres.) Cohn.

Schneider (1873) utilise les mêmes combinaisons.

c) *LES OBSERVATIONS DE SOROKIN*

L'extrait de l'article de Sorokin (1880) publié par Batalin (1881) signale à propos de *Entomophthora aphidis*:

"en dehors des spores déjà connues et habituellement allongées qui se forment à la surface du corps des insectes" (les conidies) "il se développe aussi à l'intérieur du corps des *Aphis* et à partir des mêmes filaments d'*Entomophthora*, des spores durables..." (traduit de l'allemand). Cette affirmation est surprenante parce qu'inverse de la réalité: en effet, en 1880, la seule forme connue pour cette espèce est la spore durable décrite par Fresenius, puis mentionnée par Cohn en 1870 et par Schneider 1873.

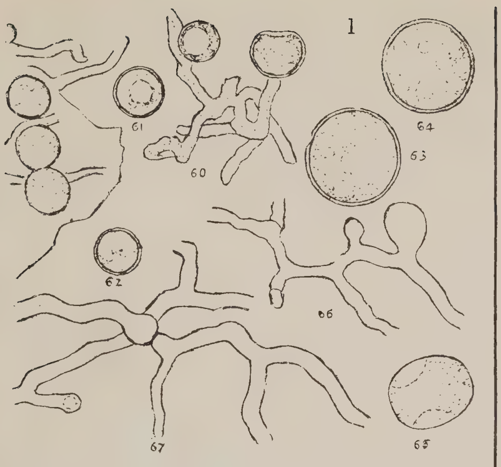
Dans le même extrait, Batalin rapporte que les spores durables sont décrites comme "rondes et grandes, à membrane stratifiée de couleur brune et couverte de reliefs (Erhöhungen)" (traduit de l'allemand); il est en outre précisé que les "spores habituelles" (c'est-à-dire les conidies) donnent des "sporidies secondaires de forme ronde". Aucune indication n'est fournie sur l'espèce de puceron attaquée, ni sur sa plante hôte.

La présence de reliefs sur les spores brunes de Sorokin peut laisser penser que les spores décrites par Fresenius avaient perdu leur épispore, mais il semble plutôt que ces auteurs traitent d'espèces distinctes, les conidies secondaires "rondes" de Sorokin ne pouvant pas être celles de *Entomophthora aphidis*.

d) *LES OBSERVATIONS DE WINTER*

Winter (1881) retrouve une mycose sur le puceron du *Cornus sanguinea* en automne 1880: les feuilles étaient densément couvertes de pucerons; certains, de couleur brun clair avec l'abdomen fortement renflé, étaient remarquables par le duvet blanc (conidiophores + conidies) qui les recouvrait tandis que sur les mêmes feuilles d'autres pucerons, momifiés, ridés, renfermaient des spores durables correspondant à celles décrites par Hoffmann in Fresenius pour *Entomophthora aphidis*. Winter en conclut que les pucerons couverts de duvet blanchâtre hébergent une autre forme de la même espèce fongique; il décrit ainsi les conidies présentes sur les spécimens blanchâtres: "spores elliptiques, en forme de fuseau, souvent dissymétriques, rarement un peu courbées, le plus souvent avec une petite pointe, incolores; longueur 26-30 µm, épaisseur 10-16 µm" (traduit de l'allemand).

Fig. 1-4. Reproduction partielle des figures originales 1, de Fresenius 1858, *Entomophthora aphidis* Hoffm. in Fres.; 2, de Nowakowski 1883, "*Entomophthora aphidis*" sensu Nowak.; 3, de Thaxter 1888, "*Entomophthora aphidis*" sensu Thaxter; 4, de Houghton & Phillips 1886, *Entomophthora ferruginea* Phill. in Hought. & Phill.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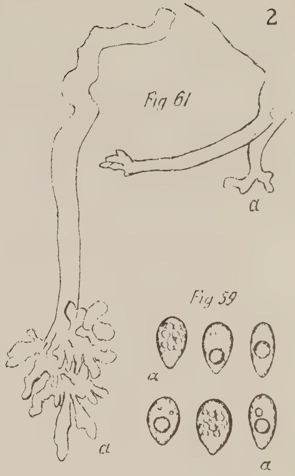
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Fig 59
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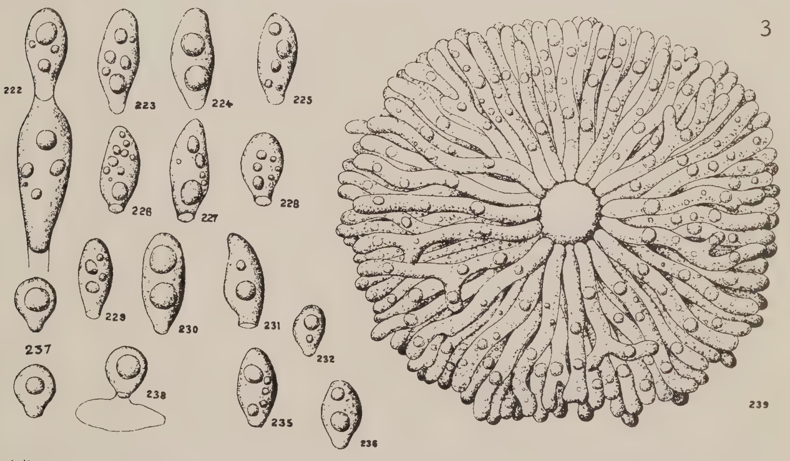
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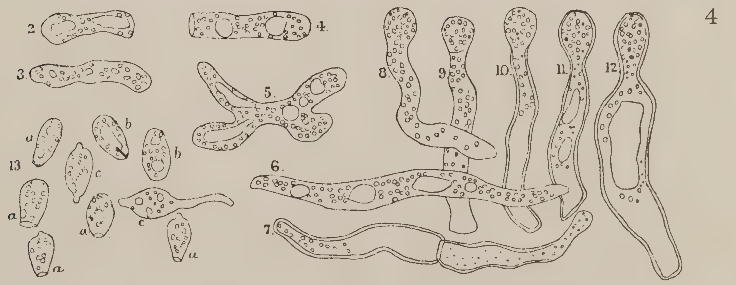
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Winter ne précise pas la position (basale ou apicale) de la petite pointe; il ne signale pas la présence de conidies secondaires.

Dans un travail postérieur, Winter (1884) décrit aussi les spores durables: "terminales ou sur de courtes branches latérales du mycélium qui est brunâtre..., 33-43 µm de diamètre, brunâtres lorsqu'elles sont jeunes, incolores lorsqu'elles sont mûres, avec une paroi épaisse, lisse et formée de 2 couches."

Il n'est pas douteux que les spores décrites par Winter appartiennent à l'espèce *Entomophthora aphidis* Hoffm. in Fres. Cet auteur cite en effet l'exsiccatum original N° 768 du Rabenhorst auquel il n'a sûrement pas manqué de comparer son propre matériel. Les conidies observées par Winter sur des cadavres de la même espèce de puceron fixés sur les mêmes feuilles que ceux contenant les spores durables correspondent probablement à une autre forme de la même espèce fongique, malgré l'absence de preuve expérimentale.

Winter (1884) n'accepte pas les genres *Empusa* Cohn (préoccupé) et *Tarichium* Cohn 1870 (créé pour les espèces dont seules les spores durables sont connues). Il place toutes les espèces d'Entomophthorées dans le genre *Entomophthora* Fres. et distingue, à l'intérieur de ce genre, 3 groupes: (A) celui dont seules les "basidiospores" (les conidies) sont connues à l'époque, (B) celui dont seules les spores durables sont connues à l'époque, (C) dont les espèces sont complètement connues (conidies + spores durables); c'est dans ce dernier groupe qu'il place *Entomophthora aphidis* Hoffm. in Fres. et *E. sphaerosperma* Fres.

e) *LES OBSERVATIONS DE NOWAKOWSKI*

Nowakowski (1883) applique le nom de *Entomophthora aphidis* Hoffm. in Fres. à un champignon qu'il rencontre communément sur différentes espèces d'Aphides. Les précisions qu'il donne sur les pucerons attaqués permettent de reconnaître les six espèces suivantes: *Macrosiphum rosae* L., *Brachycaudus cardui L.*, *Brevicoryne brassicae* L., *Aphis fabae* Scop., *Myzus persicae* Sulz. et *Aphis verbasci* Schrank, aucun puceron des *Cornus* n'est mentionné. Nowakowski précise qu'il n'a pas vu les spores durables néanmoins, et en l'absence de tout élément de comparaison, il n'hésite pas à considérer qu'il a affaire à l'espèce dont le mycélium et les spores durables ont été décrits par Fresenius.

Il décrit les conidies comme étant ovoïdes et de même aspect et mêmes dimensions que celles de *Entomophthora* *ovispora* Nowak. 1877 (c'est-à-dire avec une papille basale et mesurant 22,8-28,5 x 14,2 µm). Les hôtes portent des "paraphyses" (cystides) et sont fixés par des rhizoïdes (voir les figures 59 et 61 de cet auteur: Fig. 2).

On remarquera que les conidies de "*Entomophthora aphidis*" sensu Nowakowski ne présentent pas la petite pointe signalée par Winter, ni en position apicale, ni en position basale.

f) *LES OBSERVATIONS DE THAXTER*

Thaxter, en 1888, applique la combinaison nouvelle *Empusa aphidis* Hoffm. in Fres. à l'une des Empusées les plus communes aux Etats-Unis qu'il rencontre sur de très nombreux genres d'Aphides dont il ne précise pas les noms. Malgré l'étude d'un nombre considérable de spécimens infectés par ce champignon, Thaxter n'a jamais trouvé les spores durables; il reconnaît que, dans ces conditions, il est impossible d'affirmer que la description de Fresenius se rapporte réellement à cette espèce.

Les conidies primaires (figures 223-236 de cet auteur: Fig. 3) sont ovoïdes à elliptiques ou subfusiformes, communément asymétriques et très variables, avec une papille basale; mensurations: moyenne 25 x 12 µm, maximum 40 x 16 µm. Thaxter ne doute pas de l'identité de cette forme conidienne avec, d'une part celles décrites pour la première fois par Winter 26-30 x 10-16 µm et d'autre part, celles décrites et figurées par Nowakowski.

L'identité des conidies et, par suite, celle des espèces considérées par Nowakowski et par Thaxter n'est pas contestable; en revanche nous devons reconnaître à nouveau que les conidies de Nowakowski et Thaxter diffèrent de celles de Winter par l'absence de la "petite pointe". "*Entomophthora aphidis*" sensu Nowakowski et sensu Thaxter représentent donc une même espèce, distincte de *E. aphidis* Hoffm. in Fres.

Thaxter décrit en outre une structure particulière caractérisée par "une cellule centrale", très réfringente et entourée d'une masse d'hyphes rayonnants. La figure 239 de cet auteur (Fig. 3) permet d'estimer le diamètre de cette cellule centrale à 40 µm. Brobyn & Wilding (1977) ont démontré la nature et la fonction de cette structure: la "cellule centrale" est en réalité la cellule mère d'une cystide qui va percer la cuticule de l'hôte tandis que les hyphes qui convergent vers elle, vont profiter de cette perforation pour sortir et devenir conidiophores.

g) *LES OBSERVATIONS DE PETCH*

Petch (1939) applique le nom de *Entomophthora aphidis* Hoffm. in Fres. à un pathogène de *Pemphigus* trouvé sur racine de *Lactuca*; l'abdomen des pucerons était transformé en une masse blanche et fragile de spores durables sphériques, lisses, hyalines à paroi très épaisse (diamètre 23 à 32 µm); un unique spécimen portait des conidies ayant l'aspect de celles de *Entomophthora aphidis* mais mesurant seulement 12-18 x 9-12 µm. Pour expliquer la discordance existant entre les mensurations de ses spores (23-32 µm) et celles de la description originale de l'espèce (33-43 µm), Petch considère les "cellules centrales" figurées par Thaxter (1888) dont le diamètre, estimé à 40 µm, est comparable à celui des spores de Fresenius; s'appuyant sur la remarque de Fresenius concernant la difficulté anormale qu'il rencontre pour séparer les spores durables du mycélium chez *Entomophthora aphidis*, Petch pense que Fresenius a pu, par erreur, interpréter ces "cellules centrales" comme étant des spores durables. Le simple examen des figures 59 et 60 de Fresenius (Fig. 3) et celui des syntypes (Fig. 15) obligent à rejeter cette interprétation et dès lors à reconnaître que "*Entomophthora aphidis*" sensu Petch est une espèce distincte de *Entomophthora aphidis* Hoffm. in Fres. et, probablement aussi, différente de "*Entomophthora aphidis*" sensu Nowak. ou sensu Thaxter (en raison des dimensions très faibles des conidies et de la présence de spores durables).

h) *LES OBSERVATIONS DE KRENNER*

Krenner (1961), après une critique sévère et confuse de tous les travaux antérieurs sur *Entomophthora aphidis*, présente un fatras d'observations sur ce champignon qu'il a rencontré sur *Acyrthosiphon pisum* Harris sur luzerne. En conclusion, cet auteur donne une liste hautement fantaisiste des synonymes nouveaux de "*Entomophthora aphidis* Hoffm. emend. Krenner"; cette liste confond des espèces aussi différentes que *Empusa fresenii* Nowakowski, *Entomophthora obscura* Hall & Dunn (= *Entomophthora thaxteriana* Petch = "*Empusa planchoniana* Cornu?" de Thaxter) (Remaudière et al. 1979), *Empusa lageniformis* Thaxter et *Empusa occidentalis* Thaxter !

i) *LES OBSERVATIONS DE GROBLER ET AL.*

Grobler et al. (1962) appliquent le nom de *Entomophthora aphidis* Hoffm. in Fres. à l'un des pathogènes qu'ils observent communément sur *Schizolachnus piniradiatae* Davidson et qu'ils caractérisent par ses conidies subcylindriques mesurant (16,5)25,5(38,5) x (7)12(18) µm et ses spores durables de (29)34(43) µm (*a*) à épispore brun rougeâtre, réticulée et facilement détachable. Ultérieurement Tyrrell et al. (1975) montrent chez cette espèce l'existence de capilloconidies en forme de croissant (33 x 9 µm) qui naissent au sommet d'un tube capillaire émis par les conidies primaires.

Cette espèce particulière est aujourd'hui décrite sous le nom de *Entomophthora canadensis* MacLeod, Tyrrell & Soper (1979).

j) *LES OBSERVATIONS DE GUSTAFSSON*

Gustafsson (1965) décrit ainsi le matériel suédois qu'il rapporte à *Entomophthora aphidis*: conidies sur insectes, (18)21(25) x (7)11(14) µm, conidies obtenues de 5 cultures, 29x13, 29x15, 30x19, 32x17 et 37x17 µm (moyennes de 100 mesures); ces conidies, illustrées par la figure 75 de l'auteur (Fig. 7), se rapportent clairement aux conidies de "*Entomophthora aphidis*" sensu Nowak. et sensu Thaxter.

Parmi les 62 récoltes faites par Gustafsson entre 1959 et 1963, une seule (sur *Aphis fabae* Scop.) comportait des spécimens contenant des jeunes spores durables hyalines à brunes, avec épispore à profil étroitement cannelé, mesurant (21)30(35) µm. Ces spores durables ne peuvent se rapporter à "*Entomophthora aphidis*" sensu Nowak. qui n'en a pas; elles ont un diamètre voisin de celui des spores de "*Entomophthora aphidis*" sensu Petch mais s'en distinguent par leur pigmentation et leur ornementation; selon nous, elles pourraient être rapportées à des jeunes spores de *Zoophthora erinacea* Ben Ze'ev & Kenneth.

k) *LA NOUVELLE COMBINAISON DE BATKO*

Batko (1964b) crée le nouveau genre *Zoophthora* avec, pour espèce type, *Z. radicans* (Bref.) Batko. Dans une publication ultérieure, Batko (1964d) établit de nouvelles combinaisons parmi lesquelles *Zoophthora aphidis* (Hoffm. in Fres.) Batko. Deux ans plus tard, Batko (1966b) divise son genre *Zoophthora* en 4 sous-genres dont le subg. *Pandora* Batko 1966 avec *Zoophthora* (*Pandora*) *aphidis* (Hoffm. in Fres.) Batko comme espèce type.

La diagnose du sous-genre *Pandora* (conidies ovales, ovoïdes..., du type subpapillata... légèrement asymétriques,)

(*a*) Lorsque la ou les valeurs centrales des mensurations sont soulignées, elles expriment la moyenne ou la fourchette des moyennes de 1 ou plusieurs échantillons; exemple: (13)15(18) ou (10)12-14(20) µm.

montre que Batko applique le nom spécifique *aphidis* Hoffm. in Fres. à "*Entomophthora aphidis*" sensu Nowak. et sensu Thaxter et non à *Entomophthora aphidis* Hoffm. in Fres. dont les conidies présentent, selon Winter, une "petite pointe".

B. DESCRIPTION ORIGINALE ET APPLICATIONS DU NOM *ENTOMOPHTHORA FERRUGINEA*

a) *LA DESCRIPTION ORIGINALE DE PHILLIPS*

E. ferruginea Phill. in Hought. & Phill. (1886) est un pathogène de *Aphis fabae* Scop. sur betterave découvert en Grande-Bretagne. La description originale est imprécise; l'auteur n'a pas rencontré les spores durables mais seulement les conidies qui sont elliptiques ou subovales; les dimensions ne sont pas précisées. Les figures 8 à 12 qui accompagnent la description montrent des conidiophores portant des conidies en formation et la figure 13 représente des conidies à base tronquée, d'aspect varié avec des tubes germinatifs (Fig. 4).

Phillips a examiné un spécimen authentique de *Entomophthora aphidis* Hoffm. sur *Aphis* de *Cornus sanguinea* communiqué par M.C. Cooke (sans doute s'agit-il d'un des exsiccata N° 768 de Rabenhorst, 1858). Phillips déclare que cette espèce est essentiellement différente de son matériel trouvé sur betterave. En revanche il considère que *E. ferruginea* est très proche de l'espèce qui attaque et tue la mouche domestique, "*Empusa*" *muscae* Cohn.

Selon Hawksworth (1974), le matériel de W. Phillips est conservé dans l'herbier du Royal Botanic Gardens de Kew; malheureusement aucune trace du matériel type de *E. ferruginea* n'a été retrouvée dans cet herbier (D.A. Reid, communication personnelle).

b) *INTERPRETATION DE THAXTER ET DE LAKON*

Malgré l'affirmation de Phillips selon laquelle *Entomophthora aphidis* et *Entomophthora ferruginea* sont deux espèces distinctes qu'il a effectivement comparées, Thaxter (1888), qui n'a pu consulter le matériel authentique de *Entomophthora aphidis*, estime que la description et les figures de *Entomophthora ferruginea* concordent avec celles de l'espèce à laquelle il applique le nom de *Empusa aphidis* (="*Entomophthora aphidis*" sensu Nowak.). En conséquence, il place *Entomophthora ferruginea* en synonymie de *Empusa aphidis* (Hoffm. in Fres.) Thaxter sur la base de sa ressemblance avec "*E. aphidis*" sensu Thaxter. Il est suivi par Lakon (1919).

c) *INTERPRETATION DE PETCH, DE GUSTAFSSON ET DE MACLEOD ET AL.*

Petch (1937) constate que certaines figures originales de *Entomophthora ferruginea* montrent des conidies étroitement campanulées, parfois avec une pointe apicale. Ayant recherché, comme nous sans succès, les spécimens types, Petch considère *Entomophthora ferruginea* comme un synonyme nouveau de *Entomophthora planchoniana* Cornu 1873.

Gustafsson (1965) reprenant l'interprétation de Petch écrit que la description assez incomplète de Phillips indique indubitablement cette synonymie et non celle établie erronément par Thaxter avec *Entomophthora aphidis*.

MacLeod et al. (1976) adoptent une position moins catégorique et admettent que *Entomophthora ferruginea* est "probablement un synonyme de *Entomophthora planchoniana* plutôt que de *Entomophthora aphidis*".

d) *POSITION DE BATKO*

Batko (1966b), sans toutefois justifier sa position, accepte *Entomophthora ferruginea* qu'il considère comme une espèce voisine mais distincte de *Entomophthora aphidis* Hoffm. in Fres.; il place ainsi *E. ferruginea* dans son nouveau sous-genre *Zoophthora* (subg. *Pandora*) dont *E. aphidis* est l'espèce type.

C. DESCRIPTION ORIGINALE ET APPLICATION DU NOM *ENTOMOPHTHORA EXITIALIS*

a) *LA DESCRIPTION ORIGINALE DE HALL & DUNN*

Entomophthora exitialis Hall & Dunn (1957) est décrit de Californie comme l'un des 5 pathogènes trouvés dans les populations de *Therioaphis trifolii* Monell (= *T. maculata* Buckton) sur luzerne. L'espèce est décrite comme caractérisée par des conidies primaires ovoïdes à elliptiques, arrondies aux extrémités mesurant (17)$\underline{20}$(23) x (9)$\underline{11}$(12) µm, des conidies secondaires semblables aux primaires et des spores durables de (24)$\underline{27}$(32) µm de diamètre, à épispore lisse. Selon les auteurs, le champignon présente une légère ressemblance avec *Entomophthora aphidis* ("*Entomophthora aphidis*" sensu Nowak. et sensu Thaxter, la seule interprétation qu'ils connaissent).

Alors que le texte concerne des conidies primaires dont le rapport Longueur moyenne/Diamètre moyen (Lm/Dm) est de 1,8, les photographies (figures 8 et 9 de Hall & Dunn: Fig.

5-6) montrent des conidies dont les rapports L/D varient de 2,3 à 3,7 (L/D moyen pour 9 conidies mesurables = 3,0). L'aspect de ces conidies, subcylindriques, avec une papille basale subtriangulaire surmontée d'un épaulement caractéristique est semblable à celui des conidies de *Zoophthora radicans* (Bref.) Batko et ne correspond pas du tout à celui des conidies de "*Entomophthora aphidis*" sensu Nowak.

Travaillant sur une culture de *Entomophthora exitialis* Hall & Dunn, reçue comme authentique de I.M. Hall (Dept. of Biol. Control, Univ. of California, Riverside), Krejzova (1973) en publie des photographies (ses figures 6 à 8) montrant des conidies allongées, subcylindriques comparables à celles figurées par Hall & Dunn.

En l'absence d'exsiccatum type (Hall, communication personnelle), il n'est pas possible d'expliquer la divergence constatée entre le texte de la description originale et l'illustration qui l'accompagne.

b) *APPLICATION DU NOM* E. EXITIALIS *PAR GUSTAFSSON*

Nous avons rappelé que Gustafsson (1965) a trouvé une fois sur *Aphis fabae* des spores durables hyalines à brunes avec épispore cannelée auxquelles il applique le nom de *Entomophthora aphidis* ("*Entomophthora aphidis*" sensu Nowak.) et nous avons montré que ces spores sont voisines quoique distinctes de celles de "*Entomophthora aphidis*" sensu Petch.

Dans la même publication, Gustafsson applique le nom d'*Entomophthora exitialis* Hall & Dunn à une autre espèce d'Entomophthorales trouvée, comme la précédente, sur *Aphis fabae* sur betterave; il considère son matériel probablement co-spécifique de celui décrit par Petch (1939) sous le nom d' "*Entomophthora aphidis*" dont les spores durables sont hyalines et de même diamètre (23-32 µm) que les siennes (23-39 µm) et dont les mensurations de conidies (12-18 x 9-12 µm) lui paraissent "mieux correspondre à *E. exitialis* qu'à *E. aphidis*".

Gustafsson distingue son "*Entomophthora exitialis*" de son "*Entomophthora aphidis*" (c'est-à-dire de "*Entomophthora aphidis*" sensu Nowak.) par la rareté des cystides; il reconnaît qu'il est impossible de séparer ces deux espèces au champ et que l'on risque également de les confondre lors de l'examen des préparations.

Nous considérons que "*E. exitialis*" sensu Gustafsson et "*E. aphidis*" sensu Petch sont co-spécifiques et différents de "*E. aphidis*" sensu Nowak.

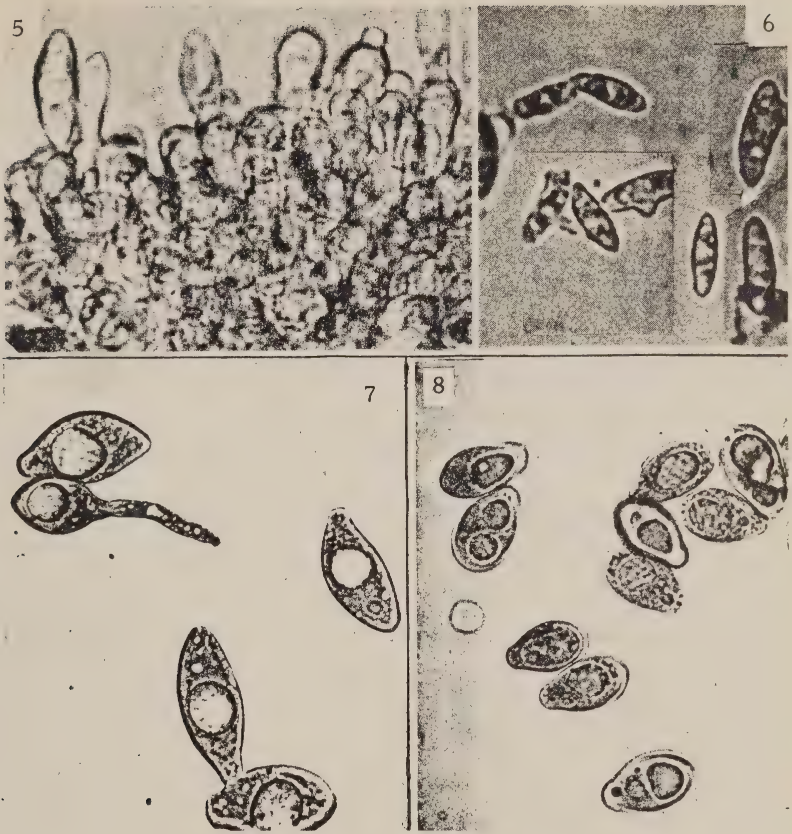


Fig. 5-8. Reproduction partielle des figures originales, 5-6, de Hall & Dunn 1957, conidiophores et conidies de *Entomophthora exitialis* Hall & Dunn; 7-8, de Gustafsson 1965, 7, conidies de *"Entomophthora aphidis"* sensu Nowak., 8, conidies de *"Entomophthora exitialis"* sensu Gustafsson.

On remarquera que les figures de *Entomophthora exitialis* publiées par Gustafsson (Fig. 8) présentent une certaine concordance avec le texte de la description originale de Hall & Dunn mais qu'elles ne correspondent pas aux photographies de conidies publiées par ces auteurs (Fig. 5-6) et par Krejzova (1973).

D. RECAPITULATION DES TAXONS IMPLIQUES

On peut résumer de la façon suivante la situation des différents taxons considérés dans les pages précédentes (les taxons reconnus sont imprimés en capitales lors de leur première description).

Entomophthora aphidis

a) Fresenius (1858), *ENTOMOPHTHORA APHIDIS* HOFFM. IN FRES. 1858.
b) Cohn (1870), *Tarichium aphidis* (Hoffm. in Fres.) Cohn ≡ *E. aphidis* Hoffm. in Fres.
c) Sorokin (1880), douteux (présence de conidies, description insuffisante).
d) Winter (1881, 1884) = *Entomophthora aphidis* Hoffm. in Fres.
e) Nowakowski (1883) = "*ENTOMOPHTHORA APHIDIS*" SENSU NOWAK.
f) Thaxter (1888) = "*Entomophthora aphidis*" sensu Nowak.
g) Petch (1939) = "*ENTOMOPHTHORA APHIDIS*" SENSU PETCH.
h) Krenner (1961), mélange de 5 espèces.
i) Grobler et al. (1962) = *ENTOMOPHTHORA CANADENSIS* MACLEOD ET AL. 1979.
j) Gustafsson (1965), conidies = "*Entomophthora aphidis*" sensu Nowak.;
spores durables: douteux, voisin mais distinct de "*E. aphidis*" sensu Petch.
k) Batko (1964d), *Zoophthora aphidis* (Hoffm. in Fres.) Batko ≡ *Entomophthora aphidis* Hoffm. in Fres. 1858, espèce type désignée pour *Zoophthora* subg. *Pandora* Batko (1966b), mais la description du sous-genre s'applique à "*Entomophthora aphidis*" sensu Nowak.

Entomophthora ferruginea

a) Phillips in Houghton & Phillips (1886), *Entomophthora ferruginea* Phill. in Hought. & Phill.
b) Thaxter (1888), Lakon (1919) = "*Entomophthora aphidis*" sensu Nowak.
c) Petch (1937), Gustafsson (1965), MacLeod et al. (1976), synonymie *Entomophthora ferruginea* = *Entomophthora planchoniana* Cornu 1873.
d) Batko (1966b), *Zoophthora* (*Pandora*) *ferruginea* (Phill. in Hought. & Phill.) Batko 1966 ≡ *Entomophthora ferruginea* Phill. in Hought. & Phill.

Entomophthora exitialis

a) Hall & Dunn (1957), *Entomophthora exitialis* Hall & Dunn = mélange de 2 espèces.
b) Gustafsson (1965) = "*Entomophthora exitialis*" sensu Gustafsson = "*Entomophthora aphidis*" sensu Petch.

En conclusion, le nom *Entomophthora aphidis* a été appliqué à 4 taxons reconnaissables:

- *Entomophthora aphidis* Hoffm. in Fres. (1858), qui sera dénommé *Zoophthora aphidis* (Hoffm. in Fres.) Batko 1964.
- "*Entomophthora aphidis*" sensu Nowak. (1883), qui sera dénommé *Erynia neoaphidis*, nov. sp.
- "*Entomophthora aphidis*" sensu Petch (1939), qui sera dénommé *Erynia nouryi*, nov. sp.
- "*Entomophthora aphidis*" sensu Grobler et al. (1962) est décrit sous le nom de *Entomophthora canadensis* MacLeod, Tyrrell & Soper 1979.

Les deux taxons *E. ferruginea* et *E. exitialis* seront classés comme confus.

2 REEVALUATION DE ENTOMOPHTHORA APHIDIS DE E. FERRUGINEA ET DE E. EXITIALIS

A. *ENTOMOPHTHORA APHIDIS* HOFFM. IN FRES., SA POSITION DANS *ZOOPHTHORA* BATKO

a) *REDECOUVERTE ET CARACTERISTIQUES DE L'ENTOMOPHTHOROSE DES* ANOECIA

Les prospections réalisées en France au cours des dernières années ont permis de retrouver et de caractériser l'entomophthorose des sexupares et sexués d'*Anoecia* sur *Cornus sanguinea*, d'identifier son agent à l'espèce *Entomophthora aphidis* Hoffm. in Fres. et, pour la première fois depuis Winter 1881, de relier ses formes conidiennes à sa forme spore durable.

En automne, la haute vallée du Giffre et la vallée de l'Arve (Haute-Savoie, France), par les nuits fraîches, se couvrent souvent d'une chape de brume qui se dissipe lentement dans la matinée. Ces conditions sont très propices au développement des mycoses à *Entomophthora* dans les populations aphidiennes et en particulier dans les colonies d'*Anoecia* rencontrées à la face inférieure des feuilles de *Cornus sanguinea* après l'installation des ailés sexupares. De nombreux sexupares d'*Anoecia* et leur descendance sexuée, atteints de mycose, ont été trouvés en septembre et octobre pendant 5 années consécutives, de 1975 à 1979. Une trentaine de souches du champignon pathogène d'*Anoecia* ont été isolées, tantôt par récupération des conidies projetées par les cadavres, tantôt par ensemencement direct de ceux-ci sur le milieu après stérilisation superficielle selon les méthodes décrites par Remaudière et al. (1976). Les conidies primaires projetées des cadavres ou des cultures sont recueillies sur lame flambée, puis sont conservées à sec ou incubées pendant une quinzaine d'heures en atmosphère saturée pour l'obtention des conidies secondaires, elles-mêmes conservées à sec. Les conidies sont colorées et montées dans le bleu trypan lactophénol juste avant mensuration.

A la face inférieure des feuilles de *Cornus sanguinea* on peut rencontrer trois types de cadavres d'*Anoecia*:

- des ailés sexupares envahis de mycélium, fixés à une nervure par les stylets du rostre; des coussinets de conidiophores (sporodochies) se développent à l'emplacement des parties membraneuses, principalement entre la tête et le pronotum, entre le pronotum et le mésonotum, le métanotum et l'abdomen ainsi qu'au niveau des articulations coxales;
- des larves et adultes mâles et femelles ovipares (aptères) et leurs larves, fixés le plus souvent sur le limbe de la feuille par les stylets, de couleur brun ocre, puis blanche lors de la sporulation du champignon: l'hôte est alors fortement déformé par le développement de volumineux coussinets de conidiophores qui font saillie à la surface du corps (Fig. 9, 12);
- des larves et adultes mâles et femelles ovipares, de couleur noir mat, à la cuticule intacte ou un peu ratatinée, (Fig. 9a, 10) fixés sur le limbe et souvent contre les nervures de la base de la feuille; la fixation est généralement assurée par les stylets, toutefois certains spécimens sont hérissés de longues cystides (Fig. 11) et présentent une masse rayonnante et dense de rhizoïdes formant comme une toile qui les attachent très solidement au substrat; dans les cas de fortes infestations, on retrouve aussi des amas de cadavres noirs à la base des pétioles et à l'aisselle des bourgeons; tous les cadavres noirs sont remplis de spores durables.

Les cadavres des deux premiers types, lorsqu'on les installe sur ouate de cellulose imbibée d'eau , émettent des conidiophores et des conidies qui sont projetées à quelques millimètres; cystides et rhizoïdes n'ont jamais été observés sur ces cadavres. Placés dans les mêmes conditions, les cadavres noirs du troisième type ne produisent jamais de conidies mais de longues cystides se développent tout autour du corps (Fig. 11), formant, sous les insectes qui en étaient dépourvus, une large toile ou plaque rhizoïdale.

Les spores durables n'ont jamais été observées chez les ailés sexupares. Les sexués produisent soit des spores dura-

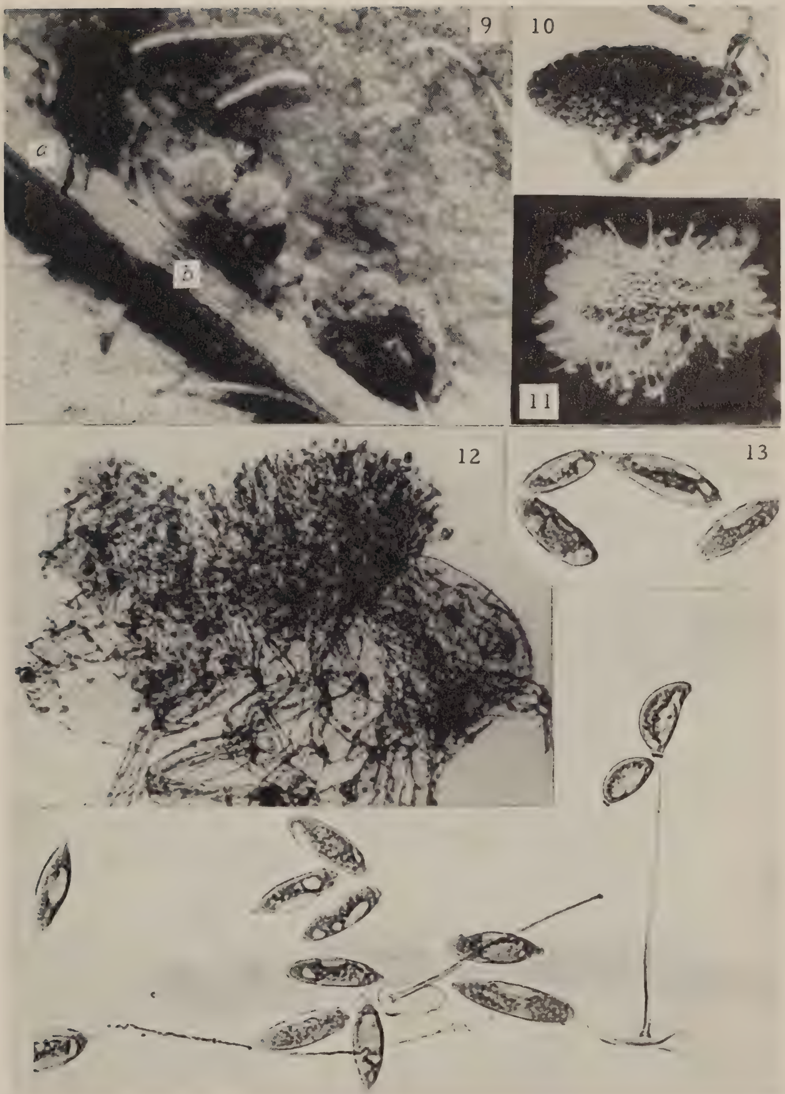


Fig. 9-13. *Zoophthora aphidis* (Hoffm. in Fres.) Batko; 9, cadavres de *Anoecia* sur *Cornus sanguinea*, a) avec spores durables, b) avec conidiophores groupés en sporodochies; 10, cadavre noir et bosselé rempli de spores durables; 11, cadavre avec spores durables ayant développé des cystides; 12, larve de *Anoecia* portant des conidiophores; 13, conidies primaires et capilloconidies.

bles, soit des conidies mais la coexistence des deux formes chez un même spécimen est exceptionnelle (1 cas observé sur près de 1000 étudiés).

Entomophthora aphidis Hoffm. in Fres. paraît hautement spécifique des *Anoecia* sur *Cornus*; il n'a jamais été rencontré sur des Aphides d'autres genres ni sur les formes estivales de ces pucerons qui colonisent les racines de Graminées.

Le puceron *Aphis salicariae* Koch (= *A. corniella* Hille Ris Lambers) qui côtoie les *Anoecia* à la face inférieure des feuilles de *Cornus* n'a jamais été trouvé affecté par la même mycose mais seulement par "*E. aphidis*" sensu Nowak.; réciproquement "*Entomophthora aphidis*" sensu Nowak. n'a pas encore été rencontré sur *Anoecia*.

b) *IDENTIFICATION DE* ENTOMOPHTHORA APHIDIS *HOFFM. IN FRES.*

Compte-tenu du risque d'infection mixte d'un insecte par plusieurs espèces d'*Entomophthora* (Humber et al. 1977), il importait de vérifier expérimentalement la relation ontogénique des spores durables et des conidies. Trois séries de souches ont été isolées à partir des trois sortes d'inoculum suivantes:

- conidies projetées par des ailés sexupares (= cadavres du premier type);
- cadavres du 2e type stérilisés superficiellement; dans les tubes de culture ces cadavres projettent des conidies qui germent sur le milieu et émettent des filaments mycéliens qui contribuent aussi à la colonisation du milieu.
- cadavres du 3e type, noirs, remplis de spores durables; le milieu est colonisé exclusivement par le développement de cystides et rhizoïdes, car aucune conidie n'est projetée de ces cadavres.

Les trois séries de souches ainsi isolées se révèlent identiques, tant par les caractéristiques des cultures, que par la morphologie des fructifications qu'elles produisent. Ces faits montrent que les spores durables et les conidies observées sur *Anoecia* appartiennent bien à la même espèce d'Entomophthorale.

La description originale d'*Entomophthora aphidis* Hoffm. in Fres. et les syntypes de cette espèce que nous avons examinés en première partie, correspondent parfaitement à l'espèce trouvée en Haute-Savoie sur le même aphide hôte. Les spores durables de Haute-Savoie (Fig. 16 et Tabl. 2) sont identiques à celle des syntypes de l'espèce (Fig. 15 et Tabl. 1).

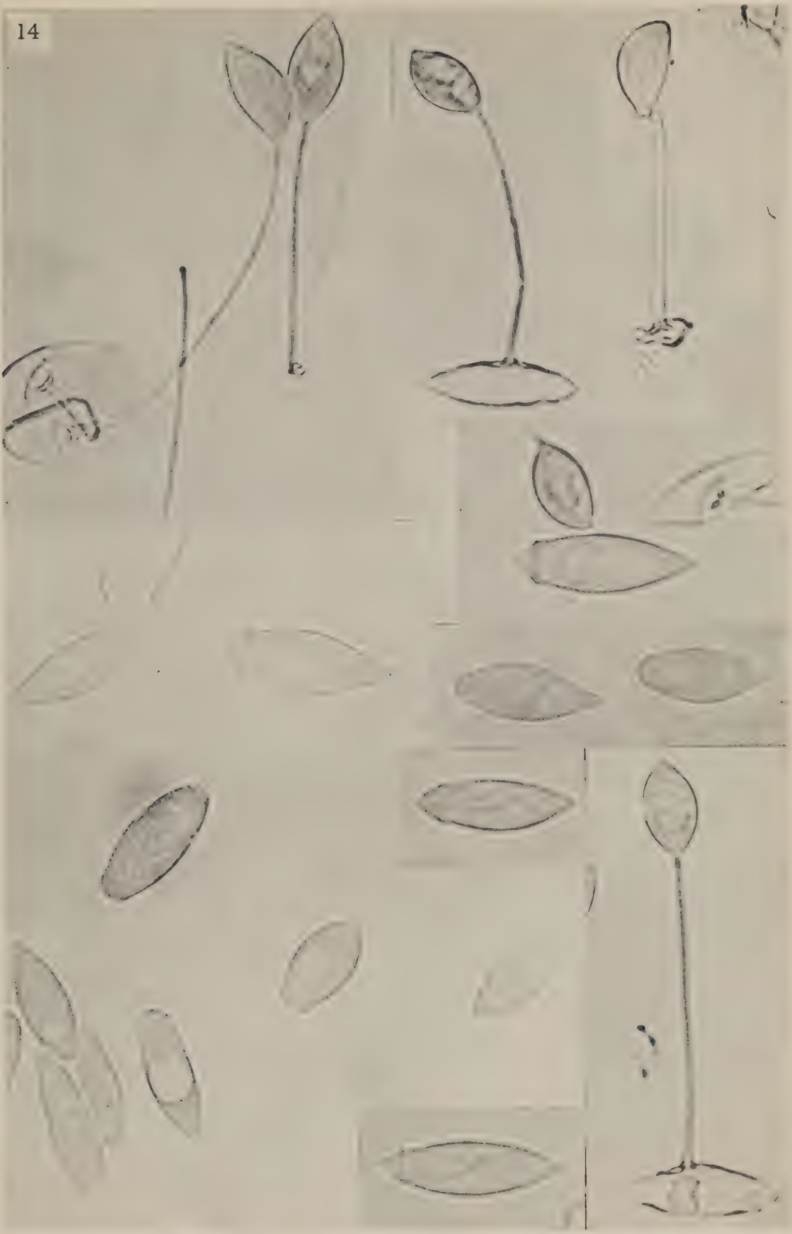


Fig. 14. *Zoophthora aphidis* (Hoffm. in Fres.) Batko, variabilité d'aspect des conidies primaires et capilloconidies ex culture.

Winter (1881) est le seul, après Hoffmann, à avoir mentionné l'entomophthorose des *Anoecia* sur *Cornus*. Sa description, brève mais plus complète que celle de Fresenius, en témoigne; les conidies qu'il décrit peuvent être rapportées aux conidies primaires, par leur aspect "en forme de fuseau, le plus souvent avec une petite pointe" ou aux capilloconidies "souvent dissymétriques, un peu courbées"; en effet, vue de face, la capilloconidie est fusiforme, vue de profil, son apex a l'aspect d'un bec émoussé, tandis que la conidie primaire est plus ou moins fusiforme et porte souvent une petite pointe au centre de la papille basale. La longueur des conidies mesurées par Winter (26-30 x 13 µm) s'accorde avec celle des conidies primaires que nous avons observées; en revanche le rapport moyen L/D, qui peut être estimé d'après les données de Winter, à 28/13 = 2,2, correspondrait aux valeurs que nous obtenons pour les capilloconidies (1,9 à 2,2).

Comme nous le montrons dans le chapitre 3, l'espèce *Entomophthora aphidis* Hoffm. n'étant pas congénérique de *Entomophthora muscae* (Cohn) Fres. mais de *Zoophthora radicans* (Bref.) Batko, en raison de ses conidies uninucléées et de ses capilloconidies amygdaliformes, c'est dans le genre *Zoophthora* Batko 1964 que nous classons le pathogène des *Anoecia*.

c) *REDESCRIPTION DE* ZOOPHTHORA APHIDIS (*HOFFM. IN FRES.*) *BATKO*

Le *mycélium* est formé de corps hyphaux, éléments sinueux, courtement ramifiés, de 60-150 x 6-10(13) µm, à contenu cytoplasmique granuleux, hyalin dans ses parties jeunes, à noyaux volumineux.
Les *conidiophores* sont plusieurs fois ramifiés de manière répétée et successive, groupés en sporodochies, cylindriques, souvent cloisonnés à la base de la ramification et produisant à chaque sommet une seule conidie apicale qui, à maturité, est libérée par projection.
Les *conidies primaires* (Fig. 13-14) sont subcylindriques à largement fusiformes, composées d'un corps à paroi double, lisse et hyaline et d'une papille basale triangulaire à semi-circulaire, séparée du corps par un léger épaulement, ornée souvent d'une petite pointe centrale et à paroi simple. Elles germent parfois en formant un court conidiophore qui projette une conidie secondaire morphologiquement semblable à la primaire mais, le plus souvent elles émettent un tube capillaire (30-130 x 1,5-2,5 µm) au sommet duquel se développe une capilloconidie qui est libérée par rupture.
Les *capilloconidies* (Fig. 13-14) sont largement amygdaliformes avec, à leur base, un coussinet annulaire; vues de profil, elles sont nettement asymétriques, renflées, avec une ligne externe semi-circulaire et une ligne interne sinuée, faiblement convexe au milieu, puis droite ou concave jusqu'à l'apex qui présente l'aspect d'un bec émoussé; vues de face, les capilloconidies apparaissent fusiformes et symétriques.
Les conidies primaires et secondaires, y compris les capilloconidies,

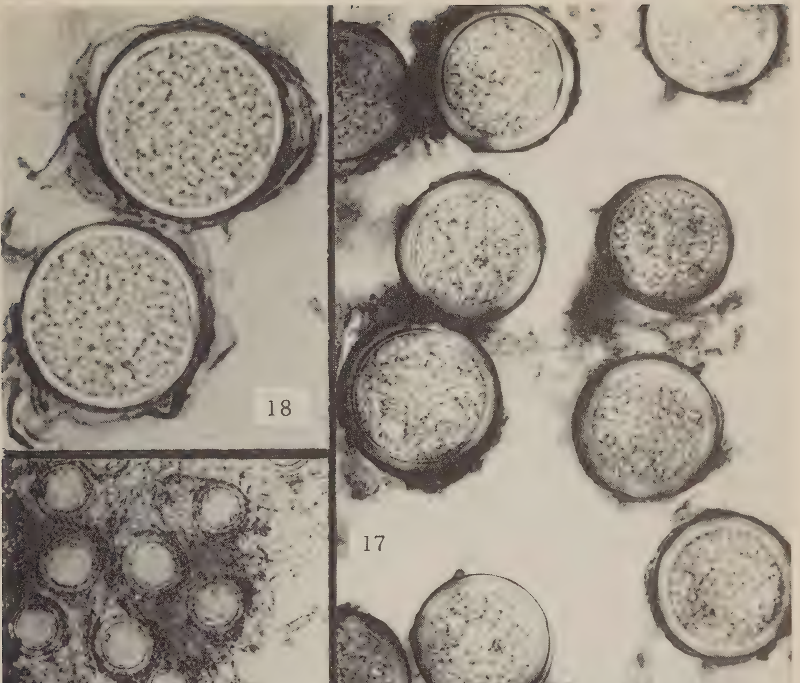


Fig. 15-19. Spores durables de *Zoophthora aphidis* (Hoffm. in Fres.) Batko; 15, ex syntype d'Hoffmann (Giessen, Allemagne 1857); 16, ex spécimen de Haute-Savoie, France 1979 (remarquer la gangue noirâtre entre les spores); 17, spores durables presque mûres, à paroi épaisse; 18, spores durables avec épispore détachée; 19, spécimen ayant développé quelques cystides.

TABLEAU 2

Mensurations de *Zoophthora aphidis* (Hoffm. in Fres.) Batko ex *Anoecia* sur *Cornus sanguinea* (exprimées en µm) (minimum, moyenne, maximum de 50 mesures par insecte ou par souche; entre parenthèses: valeurs Lm/Dm au lieu de moyenne L/D).
F: France (Haute-Savoie);
CH: Suisse (Zurich), mensurations S. Keller;
IPLB: souches Institut Pasteur, unité de Lutte Biologique.

	LONGUEUR			DIAMETRE			L/D		
	min	MOY	max	min	MOY	max	min	MOY	max
CONIDIES PRIMAIRES ex INSECTES									
F I976	25	30,I	37	8	9,3	II	2,7	3,3	3,7
F I977	26	32,0	37	8	I0,I	I2	2,7	3,2	3,9
F I978	25	28,7	34	8	9,3	II	2,6	3,I	3,6
F I979	27	30,4	34	9	I0,3	II	2,5	2,9	3,4
F I979	2I	29,9	33	9	I0,6	I2	2,I	2,8	3,3
CH 26	24	27,5	33	9	I0,3	II		(2,7)	
CH 37	24	29,7	36	I0	I2,I	I5		(2,5)	
CH 44	24	30,3	38	I0	I2,0	I6		(2,5)	
ex CULTURES IPLB									
675	30	34,6	4I	I0	II,7	I3	2,6	3,0	3,6
975	30	37,4	5I	II	I3,I	I7	2,4	2,9	3,6
979	30	35,0	4I	II	I2,3	I8	2,I	2,8	3,2
982	23	30,4	40	7	9,0	I2	2,6	3,4	4,4
985	27	36,9	57	II	I2,7	I9	2,2	2,9	3,7
985	26	36,I	49	8	I3,4	2I	2,I	2,7	3,7
I274	29	37,2	49	II	I2,5	I5	2,3	3,0	4,3
I276	3I	40,3	5I	I0	I3,2	I7	2,4	3,I	4,4
CAPILLOCONIDIES ex INSECTES									
F I976	I8	20,2	23	8	I0,7	I2	I,7	2,0	2,3
F I977	I6	23,3	30	8	I2,0	I6	I,5	I,9	2,5
F I977	I6	22,6	30	9	I2,I	I6	I,4	I,9	2,2
F I978	I5	2I,7	25	8	I0,0	I2	I,9	2,2	2,5
F I979	I7	22,3	28	8	II,I	I3	I,7	2,0	2,3
F I979	I7	22,2	27	9	I0,6	I4	I,6	2,I	2,5
CH	I7	20,3	25	8	9,9	I3		(2,I)	
ex CULTURES IPLB									
975	22	28,7	36	I2	I3,8	I6	I,7	2,I	2,5
979	I9	25,I	33	I0	I2,3	I5	I,8	2,I	2,4
985	I9	25,1	33	I0	II,6	I5	I,8	2,2	3,0
985	I6	25,2	33	8	I2,1	I6	I,8	2,1	2,4
I274	I9	27,I	35	II	I2,4	I4	I,6	2,2	2,8
I276	22	27,0	33	I2	I3,5	I5	I,7	2,0	2,4
SPORES DURABLES ex INSECTES									
F I976				33	40,6	5I			
F I976				34	40,8	49			
F I976				36	4I,I	49			
F I976				34	4I,I	46			
F I978				33	40,6	52			
F I979				3I	37,6	44			
F I979				29	35,8	4I			
F I979				30	36,0	4I			
F I979				30	4I,4	53			

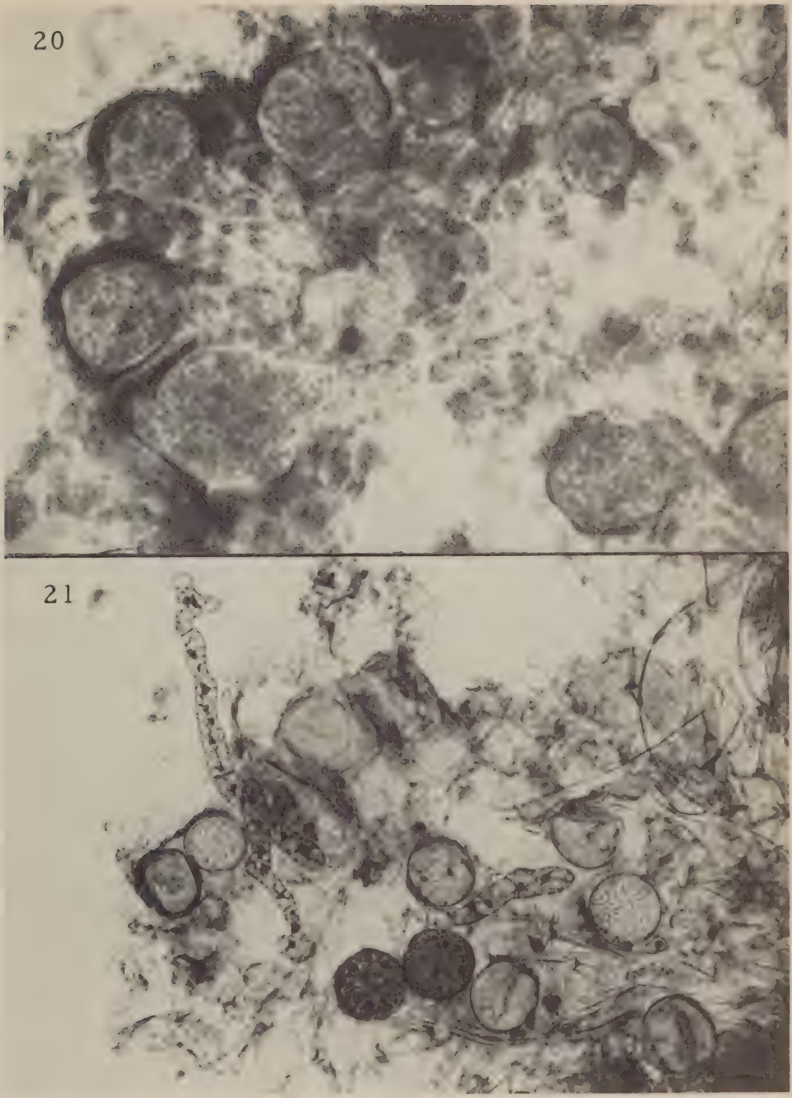


Fig. 20-21. Formation des spores durables de *Zoophthora aphidis* (Hoffm. in Fres.) Batko; 20, jeunes spores apparaissant à l'apex de corps hyphaux; 21, spores plus âgées entre lesquelles subsistent quelques hyphes interstitiels capables de former des cystides (remarquer les noyaux).

sont uninucléées, très rarement binucléées.
Les *spores durables* sont probablement des azygospores car aucune véritable image de conjugaison n'a été décelée dans les stades juvéniles; elles se forment le plus souvent à l'extrémité de segments d'hyphes internes, distincts, enchevêtrés, généralement appelés corps hyphaux; au début de leur développement, le contenu de l'hyphe s'y condense, elles deviennent pyriformes puis sphériques, elles comportent une dizaine de noyaux et sont déjà entourées d'une gangue amorphe ou membraneuse brunâtre (Fig. 20-21). A un stade plus avancé, la spore est sphérique, sa paroi s'épaissit (Fig. 17), son contenu devient uniformément granuleux; à maturité on distingue, au centre un gros globule lipidique et à la périphérie une épispore brune, fragile, ornée de légers reliefs irréguliers (Fig. 18); débarrassée de l'épispore, la spore apparaît hyaline et lisse. Dans les cadavres, les spores sont soudées par la gangue brunâtre dont il est difficile de les séparer sans léser l'épispore; en outre des corps hyphaux subsistent généralement entre les spores (Fig. 21) et peuvent donner des cystides.
Les *cystides* n'apparaissent que sur certains cadavres de sexués contenant déjà des spores durables (Fig. 19); elles sont longues, dressées, filamenteuses et indifférenciées (Fig. 12), évoluant sous le corps de l'insecte en s'enchevêtrant pour former une plaque ou subiculum rhizoïdal.

Dimensions: les valeurs moyennes des longueurs et diamètres et celles des rapports L/D des conidies primaires et des capilloconidies d'insectes et de cultures ainsi que des diamètres des spores durables d'insectes obtenues des différents lots mesurés (50 par lot), sont données dans le tableau 2 et comprises dans les fourchettes suivantes:

co. primaires insectes	27,5-33,0 x 9,3-12,1 µm; L/D 2,5-3,3
co. primaires cultures	30,4-40,3 x 9,0-13,4 µm; L/D 2,7-3,4
capilloconidies insectes	20,2-23,3 x 9,9-12,1 µm; L/D 1,9-2,2
capilloconidies cultures	25,2-28,7 x 12,1-13,8 µm; L/D 2,0-2,2
spores durables insectes	35,8-41,1 µm

Caractères culturaux. Le champignon se cultive et croît aisément sur milieu de Sabouraud enrichi de jaune d'oeuf (80/20); sur Sabouraud seul, la culture est également possible mais la croissance plus lente; sur malt, l'inoculum se développe très faiblement. La culture a un aspect blanc lisse et prend une légère couleur crème en vieillissant, la couleur du milieu n'est pas modifiée. Bien que des formations sphériques à paroi peu épaissie apparaissent parfois à partir du mycélium, il n'a jamais été rencontré de spores durables viables, le cytoplasme étant toujours lysé avant la fin d'évolution de ces structures. Une bonne croissance est également obtenue en milieu agité (eau de levure glucosée à 20g d'extrait de levure et 60g de glucose par litre); la formation de spores durables n'a pas non plus été constatée dans ce milieu liquide.

B. STATUT DE *ENTOMOPHTHORA FERRUGINEA* PHILL. IN H. & PH., *NOMEN CONFUSUM*

Ayant démontré que Nowakowski (1883), Thaxter (1888) et tous les auteurs postérieurs ont appliqué par erreur le nom de *Entomophthora aphidis* Hoffm. in Fres. à l'espèce la plus commune dans les populations de pucerons, il est nécessaire de désigner cette espèce "*Entomophthora aphidis*" sensu Nowak.

par un nom qui lui soit propre et de voir en priorité si un nom valablement publié doit lui être substitué. A ce titre, *Entomophthora ferruginea* Phill. in Hought. & Phill. peut être considéré comme un candidat.

Nous avons toutefois montré plus haut que les imprécisions de la description originale de Phillips ont conduit à trois sens différents:

- sens original comme espèce valable et distincte de "*Entomophthora aphidis*" sensu Nowak., que Batko (1966b) reclasse comme *Zoophthora* (*Pandora*) *ferruginea* (Phill. in Hought. & Phill.) Batko, mais sans en donner une redescription;
- sens de "*Entomophthora aphidis*" sensu Nowak. (Thaxter 1888; Lakon 1919);
- synonyme de *Entomophthora planchoniana* Cornu (Petch 1937; Gustafsson 1965) ou synonyme probable de *E. planchoniana* (MacLeod et al. 1976).

Phillips, qui a vu le matériel authentique de *Zoophthora aphidis* (Hoffm. in Fres.) Batko, n'a pu observer que les spores durables: fatalement les conidies de son *Entomophthora ferruginea* lui sont apparues très différentes et évidemment beaucoup plus proches des conidies de *Entomophthora muscae*; ceci explique son allusion à l'étroite parenté de *Entomophthora muscae* et de *Entomophthora planchoniana* Cornu. Gustafsson et Petch ont, semble-t-il, accordé une importance trop grande à cette allusion de Phillips et mal interprété ses figures, croyant y reconnaître *Entomophthora planchoniana* Cornu; si c'était le cas, on devrait voir la pointe apicale des conidies sur les figures 10 et 12 qui représentent un stade de développement très avancé; en outre les figures 13c (Fig. 4), qui montrent deux conidies émettant un tube germinatif à chacune de leurs extrémités, ne représentent pas un mode habituel de germination de *Entomophthora planchoniana*.

Bien que l'identité de *Entomophthora ferruginea* et "*Entomophthora aphidis*" sensu Nowak. nous paraisse probable, cette hypothèse ne peut être démontrée, pas plus que celle d'une espèce distincte, d'ailleurs mal définie, suggérée par la classification de Batko. Dans ces conditions, plutôt que de rétablir un nom qui a fait l'objet d'applications contradictoires en lui donnant un statut qui, en l'absence du type pourra toujours être contesté, nous proposons de considérer *E. ferruginea* Phill. in Hought. & Phill. comme *nomen confusum*.

C. STATUT DE *ENTOMOPHTHORA EXITIALIS* HALL & DUNN, *NOMEN CONFUSUM*

Avant d'examiner le statut à donner à "*Entomophthora aphidis*" sensu Nowak., il importe de clarifier celui de *Entomophthora exitialis*, espèce apparemment peu commune qui a été considérée par Gustafsson comme très voisine mais distincte de la précédente.

Nous avons étudié les souches suivantes qui sont enregistrées sous le nom de *E. exitialis* Hall & Dunn:

- la souche ATCC 14269 isolée de *Therioaphis trifolii* (= *T. maculata*) le 19 septembre 1955 par Hall & Dunn et qui est parvenue à l' ATCC en 1961;
- la souche CBS 180-60 reçue de Hall en 1960, qui a été remplacée en 1972 par la souche ATCC 14269;
- la souche authentique envoyée par I.M. Hall à J. Weiser à Prague (Krejzova 1973) = IPLB 1066, reçue de Mme Krejzova.

Les souches ATCC et CBS sont évidemment identiques. L'aspect des cultures, la forme sphérique des conidies, leur papille, leurs dimensions moyennes (22x18 µm) et celle des spores durables (19 µm) correspondent à *Conidiobolus thromboides* Drechsler (= *Entomophthora virulenta* Hall & Dunn d'après Latgé et al. 1980).

La souche de Prague donne des conidies primaires allongées, subcylindriques, semblables à celles qui illustrent la description originale de Hall & Dunn et des capilloconidies amygdaliformes; cette souche appartient à l'espèce *Zoophthora radicans* (Bref.) Batko dont nous donnons les caractéristiques dans le tableau 3.

Les difficultés d'interprétation de l'Entomophthorale décrite sous le nom de *Entomophthora exitialis* peuvent se résumer comme suit:

(1) il n'existe pas d'exsiccatum type (Hall, comm. pers.); aucun matériel type n'est désigné dans la description originale;

(2) la culture déposée à l' ATCC par Hall correspond à *Conidiobolus thromboides* Drechsler (= *Entomophthora virulenta* Hall & Dunn);

(3) la culture envoyée à Prague par I.M. Hall correspond à *Zoophthora radicans* (Brefeld) Batko;

(4) les illustrations originales montrent incontestablement, comme l'ont d'ailleurs récemment remarqué Milner & Teakle (1978), des conidies à épaulement, comme celles de *Zoophthora radicans*, avec un rapport L/D voisin de 3 tandis que la description originale donne des dimensions moyennes dont le rapport Lm/Dm = 20/11 = 1,8 est incompatible avec

celui des conidies figurées; ce texte pourrait s'appliquer à "*Entomophthora aphidis*" sensu Petch, comme l'a fait Gustafsson (= "*Entomophthora exitialis*" sensu Gustafsson); la description originale des spores durables ne permet pas de lever l'ambiguité car leur diamètre, (24)27(32) µm, est comparable aussi bien à celui des spores durables de *Z. radicans*, diamètre moyen compris entre 24 et 29 µm, qu'à celui de"*Entomophthora aphidis*" sensu Petch, (20)25-30(36) µm;

(5) un argument écologique peut incliner à considérer que les conidies photographiées et les spores durables décrites par Hall & Dunn correspondent effectivement à *Z. radicans* tandis que le reste de la description pourrait concerner les conidies de "*Entomophthora aphidis*" sensu Nowak. (les mesures de Hall & Dunn étant intermédiaires entre celles de "*E. aphidis*" sensu Petch et de "*E. aphidis*" sensu Nowak.); cette hypothèse est solidement étayée sur les données écologiques suivantes: en trois années de recherches assidues sur les pathogènes de *Therioaphis trifolii* en Californie, ces auteurs ont reconnu, à côté de *Entomophthora coronata* (Cost.) Kevork., 4 espèces nouvelles *E. obscura*, *E. ignobilis*, *E. exitialis* et *E. virulenta* sans jamais rencontrer - ce qui est fort surprenant - ni le très commun "*Entomophthora aphidis*" sensu Nowak., ni *Zoophthora radicans*, deux espèces pourtant fréquentes sur *T. trifolii* en Amérique du Nord; ces deux dernières espèces ont en effet été récemment isolées du même hôte dans les luzernières de la région de Mexico par J.P. Latgé (souches IPLB 1125: "*E. aphidis*" sensu Nowak. et 1117, 1118, 1181: *Z. radicans*);

(6) nous avons retourné à I.M. Hall la souche "*E. exitialis*" de Prague (*Zoophthora radicans*, selon nous); son avis est catégorique: cette culture n'est pas *E. exitialis*.

Constatant l'absence de matériel type, l'ambiguité taxonomique du protologue, l'identité de la culture originale déposée à l' ATCC à une espèce étrangère (*Conidiobolus thromboides* Drechsler) et le rejet par l'auteur d'une autre culture originale correspondant bien à l'illustration du protologue (*Zoophthora radicans*), nous devons considérer cette espèce comme un *nomen confusum* et rechercher un nom applicable à "*Entomophthora exitialis*" sensu Gustafsson ="*Entomophthora aphidis*" sensu Petch.

3 REVISION DU GENRE ZOOPHTHORA BATKO DESCRIPTION DE ERYNIA APHIDIS ET DE E. NOURYI SPP. NOV.

A. REVISION DU GENRE *ZOOPHTHORA*

Comme nous l'avons rappelé dans la première partie, Fresenius (1856) reconnaît le genre *Empusa* Cohn (1855), *nomen illegitimum*, comme *Entomophthora* Fresenius, sur la base de l'espèce type *Empusa muscae* Cohn.

En 1881, Nowakowski crée le nouveau genre *Erynia* pour *Erynia ovispora* Nowak. 1877, *Erynia curvispora* Nowak. 1877 et *Erynia conica* (*nom. nudum* en 1881), trois espèces qu'il se refuse à maintenir ou à placer dans *Entomophthora*, à côté de *E. radicans* Bref. car, contrairement à cette dernière, les trois espèces précédentes présentent des zygospores issues d'une véritable conjugaison.

En 1883, il divise l'ensemble des espèces de *Entomophthora* Fres. en trois groupes:

- celui des espèces à conidiophores simples et sans rhizoïdes - dont l'espèce type de *Entomophthora* Fres., *E. muscae* Cohn - qu'il reclasse à tort dans *Empusa* Cohn, illégitime;
- celui de l'espèce *Entomophthora culicis* (A. Cohn) Fres. à conidiophores simples mais avec rhizoïdes, pour lequel il confirme son genre *Lamia* Nowak. déjà mentionné en 1881.
- celui des espèces à conidiophores ramifiés qu'il réunit sous le nom de "*Entomophthora*", créant ainsi un homonyme postérieur, "*Entomophthora* Nowak.", illégitime vu l'exclusion de son type; dans ce dernier groupe, il reprend *Entomophthora ovispora* et *Entomophthora curvispora*, il décrit *Entomophthora conica* et rejette explicitement *Erynia* Nowak. 1881 en synonyme de *Entomophthora* Nowak. 1883.

Thaxter (1888), lui aussi, maintient l'illégitime *Empusa* Cohn; il réduit *Entomophthora* au rang de sous-genre de *Empusa* dans lequel il classe des espèces telles que *Entomophthora sphaerosperma* Fres. (= *radicans* Bref.) et *Entomophthora aphidis* Hoffm. in Fres.; comme Nowakowski, il exclut de son sous-genre *Entomophthora* l'espèce type *muscae*; il crée en outre le nouveau sous-genre *Triplosporium* Thaxter et traite *Lamia* Nowak. comme synonyme de *Empusa* subg. *Empusa*.

Nieuwland (1916), observant que *Lamia* Nowak. est illégitime parce qu'homonyme de *Lamia* Endlich. 1841, le renomme

Culicicola avec la même espèce type *Empusa culicis* A. Braun et le resépare de *Empusa*.

Batko (1964a) réaffirme la typification obligatoire de *Entomophthora* Fres. comme nom nouveau d'*Empusa* Cohn et restreint le genre aux seules espèces congénériques de *Entomophthora muscae*, c'est-à-dire à conidies campanulées avec absence de rhizoïdes et de cystides.

Batko (1964b,c) élève le sous-genre *Triplosporium* Thaxter au rang de genre pour les espèces à conidiophores simples, à conidies subsphériques multinucléées, munies d'une papille tronquée, à capilloconidies et à zygospores formées par isogamie. Il crée le genre *Entomophaga* Batko pour les espèces à conidiophores simples, dépourvues de rhizoïdes, à conidies subsphériques non campanulées, unituniquées, multinucléées. Il reconnaît le genre *Culicicola* Nieuwl. (≡ *Lamia* Nowak.) pour les espèces à conidiophores simples, pourvues de rhizoïdes et à conidies unituniquées, campanulées ou non.

Négligeant apparemment la disponibilité du genre *Erynia* Nowak., il crée encore le nouveau genre *Zoophthora* Batko qu'il typifie par *Empusa radicans* Bref. 1870. Il y transfère ensuite (Batko 1964d) 24 autres espèces dont *Entomophthora aphidis* Hoffm. in Fres. ainsi que *Entomophthora ovispora* Nowak., *Entomophthora curvispora* Nowak. et *Entomophthora conica* Nowak., les 3 espèces originales de *Erynia* Nowak. Ainsi *Zoophthora* regroupe les espèces à conidiophores ramifiés, pourvues de rhizoïdes, à conidies bituniquées, uninucléées, non campanulées.

Poursuivant son essai de clarification de la systématique des *Entomophthoraceae*, Batko (1966b) scinde son genre *Zoophthora* en 4 sous-genres:
- subg. *Zoophthora* Batko 1966, holotype *Empusa radicans* Bref. 1870;
- subg. *Erynia* (Nowak. 1881) Batko 1966, type *Entomophthora ovispora* Nowak. 1877 (lectotype pour *Erynia* Nowak. 1881);
- subg. *Pandora* Batko 1966, holotype *Entomophthora aphidis* Hoffm. in Fres. 1858;
- subg. *Furia* Batko 1966, holotype *Empusa virescens* Thaxter 1888.

Les bases morphologiques sur lesquelles s'appuie Batko pour différencier ces 4 sous-genres sont notamment la diversité des types conidiens selon la classification de Lakon (1919), le degré de vacuolisation du cytoplasme des conidies, l'épaisseur relative des conidiophores, des cystides et des rhizoïdes ainsi que les particularités des expansions terminales de ces derniers. Ces caractères, déjà subtils et variables, souvent communs à plusieurs de ces sous-genres, ne permettent ni une définition univoque de chacun d'eux, ni *a fortiori* leur maintien.

Par ailleurs, la diagnose du sous-genre *Pandora* ne correspond pas à son espèce type, *Entomophthora aphidis* Hoffm. in Fres., mais à "*Entomophthora aphidis*" sensu Nowak. par tous les éléments de la description et en particulier la forme des conidies primaires décrites et illustrées comme généralement ovales, ovoïdes, souvent à faible symétrie bilatérale, au lieu de subcylindriques allongées.

De plus, pouvant affirmer que *E. aphidis* Hoffm. in Fres., holotype de *Zoophthora* subg. *Pandora* est si proche de *Empusa radicans* Bref. 1870, holotype de *Zoophthora* Batko 1964b (et de *Z.* subg. *Zoophthora*) au point d'être nécessairement congénérique, nous devons considérer *Zoophthora* subg. *Pandora* Batko 1966 , synonyme de *Zoophthora* Batko 1964b, prioritaire, ceci en dépit des différences relevées dans les diagnoses de ces sous-genres (Article 11 du code international de nomenclature botanique).

Enfin, contrairement à ce qu'écrit Batko (1966b), le taxon *Erynia* n'a pas été invalidé par le fait que Nowakowski l'ait rejeté deux ans après l'avoir créé. En réalité, Nowakowski (1883) en a fait un synonyme facultatif (taxonomique) du genre *Entomophthora*. En rétablissant *Erynia* Nowak. 1881 au rang de sous-genre de *Zoophthora* Batko 1964, Batko ne respectait pas la règle de priorité qu'impliquait la priorité de *Erynia* sur *Zoophthora* par le fait de l'inclusion de son espèce type.

Parmi les 25 espèces classées dans le genre *Zoophthora* par Batko (1964b), nous constatons l'existence d'un premier groupe très homogène et bien caractérisé par l'aptitude à former des capilloconidies à symétrie bilatérale, de type amygdaliforme ou falciforme; les espèces du groupe ont des conidies primaires produites sur des conidiophores ramifiés; ces conidies sont subcylindriques, allongées, généralement uninucléées, avec une papille basale séparée du corps de la conidie par un léger épaulement. Le nom générique *Zoophthora* Batko 1964 s'applique à ce groupe d'espèces puisque son type *Empusa radicans* Bref. en fait lui-même partie.

Nous proposons de réunir en un second groupe les autres espèces à conidies primaires généralement uninucléées et produites sur conidiophores ramifiés (comme dans le groupe précédent, *Zoophthora*) mais qui ne donnent jamais de capilloconidies. Bien que moins homogène, ce deuxième groupe mérite d'être rassemblé dans un même taxon générique auquel le nom

Erynia Nowak. 1881 s'impose du fait de l'inclusion de son lectotype *E. ovispora* (Nowak. 1877) Nowak. 1881, désigné par Batko (1966b).

En conclusion, nous distinguons deux genres d'Entomophthoracées présentant des conidiophores ramifiés, des conidies généralement uninucléées et souvent aussi des rhizoïdes: *Zoophthora* Batko et *Erynia* Nowak.

1. Genre *ZOOPHTHORA* Batko 1964 (*Bull. Acad. Polon. Sci. cl. II, ser. Sci. biol. 12*: 323-324)

≡ *Zoophthora* subg. *Zoophthora* Batko 1966 (*Acta mycol. 2*: 16-18)
= *Zoophthora* subg. *Pandora* Batko 1966 (*Acta mycol. 2*: 18-19)

Espèce type: *Empusa radicans* Bref. 1870 (*Bot. Zeitg. 28*: 161-166, 177-186) ≡ *Z. radicans* (Bref. 1870) Batko 1964 (*Bull. Acad. polon. Sci. cl. II, ser. Sci. biol. 12*: 323-324) (= "*Empusa sphaerosperma* Fres." sensu Thaxter 1888).

Principal caractère distinctif: présence de capilloconidies.
Principales espèces du genre:

Z. aphidis (Hoffm. in Fres. 1858) Batko 1964;
Z. canadensis (MacLeod et al. 1979) comb.nov. ≡ *Entomophthora canadensis* MacLeod et al. 1979 (*Can. J. Bot. 57*: 2663-2672);
Z. elateridiphaga (Turian 1978) Ben Ze'ev & Kenneth 1980;
Z. geometralis (Thaxter 1888) Batko 1964;
Z. occidentalis (Thaxter 1888) Batko 1964;
Z. phalloides Batko 1966;
Z. phytonomi (Arthur 1886) Batko 1964.

2. Genre *ERYNIA* Nowak. 1881 (*Djenn. III Zjazdu Lek. Przyr. Polsk. Kraków 6*: 67)

≡ *Zoophthora* subg. *Erynia* (Nowak. 1881) Batko 1966 (*Acta mycol. 2*: 18)
= *Zoophthora* subg. *Furia* Batko 1966 (*Acta mycol. 2*: 20) syn. nov.

Espèce lectotype: *Entomophthora ovispora* Nowak. 1877 (*Bot. Zeitg. 35*: 220) ≡ *Erynia ovispora* (Nowak. 1877) Nowak. 1881 (*Djenn. III Zjazdu Lek. Przyr. Polsk. Kraków 6*: 67).

Principal caractère distinctif: absence de capilloconidies.
Principales espèces du genre:

E. americana (Thaxter 1888) comb. nov. ≡ *Empusa americana* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 179-180, fig. 262-273);
E. aquatica (Anderson & Ringo 1969) comb. nov. ≡ *Entomophthora aquatica* Anderson & Ringo 1969 (*J. Invert. Pathol. 13*: 386-393, fig. 1-12);

E. blunckii (Lakon ex Zimm. 1978) comb. nov. ≡ *Entomophthora blunckii* Lakon ex Zimm. 1978 (*Entomophaga 23*: 181-187, fig. 1-5 (*Entomophthora blunckii* Lakon 1935 est *nomen invalidum* car sans diagnose latine);
E. brahminae (Bose & Mehta 1953) comb. nov. ≡ *Entomophthora brahminae* Bose & Mehta 1953 (*Trans. Brit. Mycol. Soc. 36*: 52-56, fig. 1-11);
E. bullata (Thaxter in Povah 1935) comb. nov. ≡ *Entomophthora bullata* Thaxter in Povah 1935 (*Papers Mich. Acad. Sci. 20*: 120);
E. calliphorae (Giard 1879) comb. nov. ≡ *Entomophthora calliphorae* Giard 1879 (*Bull. Sci. Fr. et Belg. 11*: 356-358);
E. caroliniana (Thaxter 1888) comb. nov. ≡ *Empusa caroliniana* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 167, fig. 91-105);
E. conica (Nowak. 1883) comb. nov. ≡ *Entomophthora conica* Nowak. 1883 (*Pamietn. Wydz. Akad. Umiej.w. Kraków 8*: 155-160, fig. 1-32 (la combinaison *Erynia conica* Nowak. 1881 est invalide, l'épithète *conica* étant nomen nudum en 1881, comme d'ailleurs en 1882 sous la combinaison *Entomophthora conica* Nowak. 1882);
E. creatonoti (Yen 1962) comb. nov. ≡ *Entomophthora creatonoti* (ut "*creatonotus*") Yen 1962 (*J. Insect Pathol. 4*: 88-94, fig. 1-4);
E. curvispora (Nowak. 1877) Nowak. 1881;
E. dipterigena (Thaxter 1888) comb. nov. ≡ *Empusa dipterigena* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 177, fig. 241-250);
E. echinospora (Thaxter 1888) comb. nov. ≡ *Empusa echinospora* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 180, fig. 286-305);
E. erinacea (Ben Ze'ev & Kenneth 1979) comb. nov. ≡ *Zoophthora erinacea* Ben Ze'ev & Kenneth 1979 (*Mycotaxon 10*: 219-232, fig. 1-10);
E. gloeospora (Vuillemin 1886) comb. nov. ≡ *Entomophthora gloeospora* Vuillemin 1886 (*Bull. Soc. Sci. Nat. Nancy, sér. 2, 19*: 34-46, fig. 1-16);
E. gracilis (Thaxter 1888) comb. nov. ≡ *Empusa gracilis* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 185-186, fig. 379-391);
E. montana (Thaxter 1888) comb. nov. ≡ *Empusa montana* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 180, fig. 274-285);
E. myrmecophaga (Turian & Wuest 1977) comb. nov. ≡ *Zoophthora myrmecophaga* Turian & Wuest 1977 (*Bull. Soc. ent. Suisse 50*: 285-289, fig. 1-4) (*Entomophthora myrmecophaga* Turian & Wuest 1969 est *nomen invalidum* car sans diagnose latine);
E. phalangicida (Lagerheim 1898) comb. nov. ≡ *Empusa phalangicida* Lagerheim 1898 (*Bihang Till K.Sv. vet. Akad. Handl. 24 III*: 12-15, fig. 1-7);
E. rhizospora (Thaxter 1888) comb. nov. ≡ *Empusa rhizospora* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 183-185, fig. 347-378);
E. sepulchralis (Thaxter 1888) comb. nov. ≡ *Empusa sepulchralis* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 181-182, fig. 306-326);
E. variabilis (Thaxter 1888) comb. nov. ≡ *Empusa variabilis* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 183, fig. 327-346);
E. virescens (Thaxter 1888) comb. nov. ≡ *Empusa virescens* Thaxter 1888 (*Mem. Boston Soc. Hist. Nat. 4*: 178, fig. 251-261);
E. vomitoriae (Rozsypal 1966) comb. nov. ≡ *Zoophthora vomitoriae* Rozsypal 1966 (*Acta mycol. 2*: 23-24).

Les deux nouvelles espèces décrites à la fin du présent article sont également à ranger dans le genre *Erynia*: *E. neoaphidis* sp. nov. et *E. nouryi* sp. nov.

La question peut se poser de savoir pourquoi nous maintenons, à l'instar de Batko (1964b), l'épithète *radicans*

Bref. 1870 plutôt que d'user de l'épithète prioritaire *sphaerosperma* Fres. 1856.

Brefeld (1877b) a démontré la bonne correspondance des spores durables de son espèce avec les caractères révélés par Fresenius sur *Entomophthora sphaerosperma*, montrant ainsi, d'une certaine manière, l'identité des espèces, sans toutefois tirer la conclusion logique de la priorité de l'épithète *sphaerosperma* Fres. sur *radicans* Bref. (comme allaient le faire plus tard, Giard 1879, Winter 1884, Thaxter 1888, et de nombreux autres auteurs).

Batko (1964b) rejette comme nomen confusum *Entomophthora sphaerosperma* en vertu de l'article 70 du code international de nomenclature permettant de rejeter un nom dont le type est hétérogène. En effet, dans les illustrations originales de *Entomophthora sphaerosperma* Fres. (seul élément type en l'absence du matériel type, en vertu de l'article 9, note 1), Batko reconnaît des éléments discordants comme les hyphes de la figure 69 de Fresenius qui, probablement, appartiennent à un champignon non Phycomycète.

Nous appuyant sur le même article 70 du code (selon lequel on peut ne pas rejeter un type hétérogène s'il est possible de retenir comme type satisfaisant un seul de ses éléments), nous retenons les figures 72 à 78 de Fresenius comme lectotype de *Entomophthora sphaerosperma* qui représentent bien les corps hyphaux et les spores durables d'une espèce d'*Entomophthora* que nous classons *nomen dubium* (et non *nomen confusum*), tant que la découverte d'un matériel type ou authentique ou celle d'un matériel postérieur de l'auteur n'aura pas permis de préciser et confirmer l'espèce de Fresenius.

Par l'application d'une démarche rigoureuse, nous avons réussi à reconnaître et à classer *Entomophthora aphidis* Hoffm. in Fres., ce qui n'était pas possible avant la redécouverte du type, la parfaite connaissance des deux formes de l'espèce et la démonstration de leur lien ontogénique.

Cette démarche est la seule qui permette de décider du statut d'espèces telles que *Entomophthora sphaerosperma* Fres., *Tarichium megaspermum* Cohn et *Tarichium* spp., toutes décrites à l'origine - comme *Entomophthora aphidis* - sur la seule forme spore durable.

Ainsi Bucher & MacLeod (1974) ont eu raison de ne pas conclure hâtivement à une synonymie entre *Tarichium megaspermum* Cohn et *Entomophthora virescens* Thaxter, espèces qui, selon ces auteurs, coexistent dans les populations de deux

Lépidoptères *Noctuidae* du genre *Euxoa*. En l'absence de comparaison avec le matériel type, il n'est pas démontré que les spores durables qu'ils observent soient celles de *T. megaspermum*, bien que, dans ce cas, la présomption soit forte. La relation entre ces spores durables et les conidies de *Entomophthora virescens* n'est pas prouvée: les deux formes n'ont pas encore été observées sur un même individu et, même si c'était le cas, il resterait encore à démontrer que cette coexistence n'est pas le résultat d'une infection mixte par deux espèces distinctes.

La prudence manifestée par Bucher & MacLeod est d'autant plus justifiée qu'il s'agit d'une espèce type (*megaspermum* est le type de *Tarichium* Cohn 1870), toute synonymie impliquant dès lors des remaniements de la nomenclature générique.

B. DIAGNOSE DE *ZOOPHTHORA APHIDIS* HOFFM. IN FRES.

Zoophthora aphidis (Hoffm. in Fres.) Batko 1964
≡ *Entomophthora aphidis* Hoffm. in Fres. 1858
≡ *Tarichium aphidis* (Hoffm. in Fres.) Cohn 1870
≡ *Empusa aphidis* (Hoffm. in Fres.) Thaxter 1888, non "*Empusa aphidis* (Hoffm. in Fres.) Thaxter" sensu Thaxter 1888.

Diagnose (Fig. 1, 9-21):

Conidiophores ramifiés. *Conidies primaires* uninucléées, subcylindriques à fusiformes avec papille basale souvent conique pointue, plus rarement arrondie, bordée d'un épaulement, (21)27-32(38) x (8)9-12(16) µm, rapport L/D (2,1)2,5-3,2(3,9). *Conidies secondaires* parfois du même type que les primaires et formées sur des conidiophores épais, de longueur variable; plus souvent du type capilloconidies, apparaissant au sommet d'un tube capillaire. *Capilloconidies* largement amygdaliformes avec un bec émoussé, (15)20-23(30) x (8)10-12(16) µm, rapport L/D (1,4)1,9-2,2(2,5). *Spores durables*, probablement azygospores, volumineuses, coalescentes, à épispore brune pourvue de légers reliefs amorphes et irréguliers, (29)37-40(53) µm. *Corps hyphaux* sinueux, courtement ramifiés 60-150 x 6-10(13) µm. *Cystides* longues, flexueuses, rencontrées seulement sur spécimens remplis de spores durables et ayant été en présence d'eau, évoluant sous l'insecte en un subiculum rhizoïdal.
Hôte: Anoecia spp. (*Hom. Aphididae*) sur *Cornus sanguinea*.
Distribution géographique: Allemagne, Pologne, Suisse et France.
Type: Rabenhorst Klotzschii herbarium vivum mycologicum Ed. II Cent. VIII n. 768, *Entomophthora aphidis* Hoffmann sur *Anoecia* sp. sur *Cornus sanguinea*, Giessen, automne 1857, H. Hoffmann (lectotype: Herb. PC); autres syntypes Herb. PAV, K).
Autres collections, toutes sur *Anoecia* spp. sur *Cornus sanguinea:* (1) Puławy Pologne, octobre 1926, W. Siemaszko (Herb. E); (2)18 récoltes, Samoëns et Sixt dans la vallée du Giffre, Sallanches et Passy dans la

vallée de l'Arve, Haute-Savoie, France, automnes 1975 à 1979, G. Remaudière, J.P. Latgé et B. Papierok (coll. G.R., Institut Pasteur Paris) (Tableau 2); (3) 1 récolte Le Creux-de-Miège, Hérault, septembre 1977, France, Mme Matile (coll. G.R.); (4) 1 récolte Brie-Comte-Robert, Seine-et-Marne, France, octobre 1979, G. Remaudière (coll. G.R.); (5) Zurich, Suisse, octobre 1977, S. Keller (coll. S.K.).
Cultures: N° IPLB 670 à 675, 975 à 982, 985, 997, 1274 à 1280, Institut Pasteur, unité de Lutte Biologique contre les Insectes. La souche IPLB 1274 est déposée à l' ATCC, au CBS et à l' IMI (N° IMI 245781).
Principales applications et descriptions erronées: Depuis Nowakowski (1883) et jusqu'à ce jour, tous les auteurs font une application erronée du nom *E. aphidis* Hoffm. in Fres. Dans la première partie, nous avons discuté les principaux articles présentant un intérêt taxonomique: Nowakowski (1883), Thaxter (1888), Petch (1939), Krenner (1961), Grobler et al. (1962), Gustafsson (1965), Batko (1966b), Tyrrell et al. (1975). Dans les très nombreuses publications parues durant cette période de près d'un siècle et traitant du comportement, du spectre d'hôtes et de l'épizootiologie de l'espèce fongique la plus fréquente dans les populations aphidiennes, le nom de *E. aphidis* Hoffm. in Fres. est quasi invariablement utilisé par erreur pour désigner le taxon différent "*E. aphidis*" sensu Nowak.

Comparaison de *Z. aphidis* avec les autres *Zoophthora* pathogènes d'Aphides

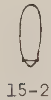
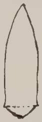
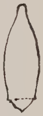
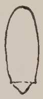
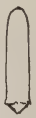
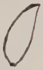
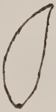
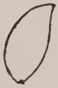
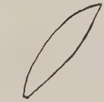
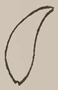
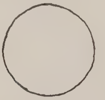
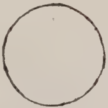
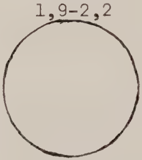
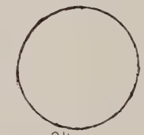
Hormis *Zoophthora aphidis*, 4 autres espèces de ce genre sont connues comme pathogènes stricts ou occasionnels d'Aphides:

Z. radicans (Bref.) Batko, qui attaque des insectes de divers ordres,
Z. phalloides Batko, qui se rencontre sur plusieurs genres d'Aphides,
Z. canadensis (MacLeod et al.) Remaudière & Hennebert, pathogène des *Schizolachnus*,
Z. occidentalis (Thaxter) Batko, surtout connu sur pucerons du bouleau.

La comparaison des caractères morphologiques de ces espèces et la clé d'identification se basent sur les données de la littérature, complétées par nos données personnelles. Dans le cas de *Z. occidentalis*, cette espèce n'ayant été signalée qu'une fois (Petch 1948) depuis la description originale (Thaxter 1888), nous avons étudié le matériel conservé au Farlow Herbarium (FH): matériel type N° 4345 et authentique N° 4344, 4346, 4347 et 6416 de Thaxter. Selon Thaxter, les hôtes sont des pucerons vivant sur *Betula populifolia*; l'examen de ses spécimens permet de reconnaître une espèce du genre *Euceraphis* (probablement *E. betulae* Koch). En France, à Pontcarré (Seine-et-Marne) nous avons retrouvé *Z. occidentalis* dans une population d'*Euceraphis betulae* Koch sur *Betula verrucosa* le 5 novembre 1977 et

TABLEAU 3

Comparaison des 5 espèces de *Zoophthora* rencontrées sur Aphides: *Z. radicans*, *Z. occidentalis*, *Z. aphidis*, *Z. canadensis* et *Z. phalloides* (fourchettes des longueurs ou diamètres moyens, Lm et Dm en µm et fourchettes des rapports moyens L/D moy.).

	RADICANS	OCCIDENTALIS		APHIDIS	CANADENSIS	PHALLOIDES
		USA	France			
CONIDIES PRIMAIRES						
Lm	15-22	30-35	34	28-32	25	26-34
Dm	5,5-7,5	9,5-11	10,6	9-12	10	6-8,5
L/D	2,4-3,0	2,8-3,1	3,2	2,5-3,3	2,5	3,9-4,5
CAPILLOCONIDIES						
					(a) (b)	
Lm	13-22	27	29	20-23	33 20	20-23
Dm	5-7	9,5	8,5	10-12	9 8,5	6-8,3
L/D	2,7-3,7	2,9	3,4	1,9-2,2	3,7 ? 2,4	2,8-3,4
SPORES DURABLES						inconnues
Dm	24-29	27-29	28	36-41	34	
Pigmentation	incolores			brunes		
HÔTES	divers ordres	Euceraphis		*Anoecia*	*Schizolachnus*	Aphides

(*a*) selon Tyrrell & al.(1975)
(*b*) selon MacLeod & al.(1979)

nous avons isolé une série de souches de ce pathogène (IPLB 1005 à 1010).

Les valeurs mentionnées dans le tableau 3 et dans la clé sont les fourchettes des moyennes obtenues sur des séries de 50 conidies ou spores durables issues d'insectes hôtes (dans le cas de *Z. canadensis*, le nombre d'individus sur lesquels portent les moyennes ne peut être précisé). Les abréviations suivantes ont été retenues:

co., conidie primaire	Lm, longueur moyenne
cap., capilloconidie	Dm, diamètre moyen
sp.d., spore durable	L/Dmoy moyenne des rapports L/D

La clé suivante permet assez facilement de séparer les 5 espèces considérées ici:

1 - *co.* L/Dmoy 3,9-4,5, Lm 26-34 µm; *cap.* arquée. . . . *Z. phalloides*
  - *co.* L/Dmoy<3,5. 2

2 - *sp.d.* incolore, Dm 30 µm 3
  - *sp.d.* à épispore brune, Dm 33 µm 4

3 - *co.* Lm 15-22 µm, cylindriques; *cap.* Lm 13-22 µm . . *Z. radicans*
  - *co.* Lm 30-35 µm, apex souvent conique; *cap.* Lm 27-29 µm . . . . *Z. occidentalis*

4 - *co.* Lm 28-32 µm, apex souvent conique; *cap.* L/Dmoy 1,9-2,2; *sp.d.* 36-41 µm . . . . *Z. aphidis*
  - *co.* Lm 25 µm, cylindrique; *sp.d.* 34 µm . . . . . . *Z. canadensis*

Ainsi *Zoophthora aphidis* se distingue de *Z. phalloides* par ses conidies primaires et ses capilloconidies bien plus larges, de *Z. radicans* par ses conidies et spores durables beaucoup plus grandes; *Z. aphidis* se rapproche de *Z. occidentalis* par la forme des conidies primaires souvent coniques à l'apex mais ses spores sont brunes; elle se rapproche aussi de *Z. canadensis* par ses spores brunes et volumineuses mais celles-ci ne sont pas cannelées et ses conidies primaires et capilloconidies ont une forme très différente (voir Tableau 3).

C. DESCRIPTION DE *ERYNIA NEOAPHIDIS* SP. NOV.

Erynia neoaphidis sp. nov.

(= "*Entomophthora aphidis*" sensu Nowak. 1883, sensu Thaxter 1888, sensu auctorum posteriorum; non sensu Petch 1939; non sensu Grobler et al. 1962, non sensu Tyrrell et al. 1975).

Diagnose (latine et française) (Fig. 22-25).

Fungus entomogeneus (Entomophthoraceae). Conidiophori *ramosi, varii, 55-130* x *6-10 µm, paliformibus.* Primaria conidia *uninucleata, hyalina, ovoidea vel elliptica, dorso-ventraliter asymetrica, in apice rotunda, cum angusta, sine conidiophori vestigio, pariete ad conidii corporem continuo, papilla, varia, in insectis (15)21-32(40)* x *(9)11-14(16) µm, L/D (1,4)1,7-2,3(2,9), in cultura (15)21-37(42)* x *(7)11-17,5(22) µm, L/D (1,2)1,6-2,6(3,5) (ultima et media dimensio).* Secondaria conidia *sive primariis conidiis similia atque parvioria, ovoidea, L/D minore, sive subsphaerica, cum conspicua papilla, saepe cum minuto, punctiformi, obscuriore atque* Entomophthora muscae *simili apiculo in apice ornata, (14)19(24)* x *(11)16(20) µm, L/D (1,1)1,2(1,4).* Hyphalia corpora *vere varia 32-260* x *6-13 µm, saepe multiramosa, cum vacuoloso cytoplasmate et 1-12, 6-8 µm latis nucleis.* Cystidia *e globosa, 30-40 µm diam., matricali cellula ennata, basaliter 12-14 µm lata, ad apicem 7-9 µm attenuata et rotundata, 120-240 µm longa, conidiophoribus supersedentia, 10-15 nucleata.* Rhizoidea *hyalina, tenua, una hypha composita, numerosa (15-30), e thoraci et ventre hospitis ennata, varie longa, 80-400 µm, 10-25 µm diam., ad substratum cum irregulare terminali disco affixa.*

Perdurantes sporae *ignotae*. Hospes: *in Homopteris, Aphididis. Vere frequens in Asia, Europa, Africa septentrionali, America septentrionali, Australia, rarior in tropicalibus regionibus.* Typus: *in* Nasonovia ribisnigri *Mosley ad* Ribem alpinum, *Samoens, Alta Savoya, Francia, 25 oct. 1979 (G. Remaudière) in PC herbario; isotypus: IPLB 1284, cultura exsiccata in K, E, PAV, FH herbariis deposita.*

Conidiophores ramifiés, de longueur et de diamètre variables 55-130 x 6-10 µm, disposés en palissade. *Conidies primaires* uninucléées, hyalines, ovoïdes à elliptiques, arrondies au sommet, généralement à asymétrie dorso-ventrale, avec une papille assez étroite, non séparée du corps de la conidie, sans marque d'attachement au conidiophore, de forme et dimensions très variables; dimensions moyennes et extrêmes (ex Tableau 4): ex insectes: (15)21-32(40) x (9)11-14(16) µm; rapport L/D (1,4)1,7-2,3(2,9) ex cultures: (15)21-37(42) x (7)11-17,5(22) µm; rapport L/D (1,2)1,6-2,6(3,5). *Conidies secondaires* généralement semblables aux primaires mais un peu plus petites, plus ovoïdes et à rapport L/D plus faible, ou bien subsphériques avec une papille bien marquée et parfois une petite bosse apicale ou apicule ponctiforme, moins évidente que chez *Entomophthora muscae* (Cohn) Fres. mais du même type, dimensions (14)19(24) x (11)16(20); rapport L/D (1,1)1,2(1,4). Corps hyphaux très variables 32-260 x 6-13 µm, avec souvent plusieurs ramifications, plus ou moins vacuolisés, avec 1 à 12 gros noyaux de 6-8 µm de diamètre. *Cystides* issues d'une cellule mère sphérique de 30 à 40 µm de diamètre, larges à la base (12-14 µm), plus fines à l'apex (7-9 µm), allongées (120-240 µm), plus longues que les conidiophores, arrondies à l'apex, contenant 10 à 15 noyaux. *Rhizoïdes* hyalins, très fins, monohyphaux, nombreux (15 à 30), issus du thorax et de l'abdomen de l'hôte, de longueur très variable liée à la distance entre le cadavre de l'hôte et la plante support (80 à 400 µm, diamètre 10 à 25 µm), fixés au substrat par une plaque adhésive irrégulièrement circulaire. *Spores durables* inconnues.

Hôtes: très nombreux genres d'Homoptères *Aphididae*.

Distribution géographique: Asie, Europe, Afrique du Nord, Amérique du Nord, Australie; vraisemblablement commune partout quoique plus rare dans les régions tropicales.

Holotype: un individu infecté (monté sur lame) de *Nasonovia ribisnigri* Mosley sur *Ribes alpinum*, Les Allamands, Samoëns, Haute-Savoie, France, 25 X 1979, G. Remaudière. *Isotypes*: les exsiccata de la culture IPLB 1284 isolée de l'individu holotype, les cadavres de *Acyrthosiphon pisum* Harris et de *Sitobion avenae* Fabricius infectés expérimentalement par cette culture et conservés en alcool à 70 % et à sec, les conidies primaires projetées de ces cadavres et de la culture IPLB 1284 et conservées en partie à sec sur lames et en partie montées dans le bleu trypan lactophénol. L'holotype et des isotypes sont déposés au Laboratoire de Cryptogamie du Muséum National d'Histoire Naturelle, Paris (PC); des isotypes sont déposés dans les herbiers suivants: K, E, PAV, FH.

Autres collections: 14 récoltes mentionnées dans le Tableau 4 et plusieurs centaines faites en France, au Moyen-Orient, en Amérique du Nord (Canada, USA, Mexique) par G. Remaudière, J.P. Latgé, B. Papierok et G. Thoizon; elles sont conservées dans la collection G.R., Institut Pasteur Paris.

Culture: la souche IPLB 1284, ex holotype, est maintenue à IPLB et déposée à l'ATCC, au CBS, et à l' IMI (N° IMI 245780).

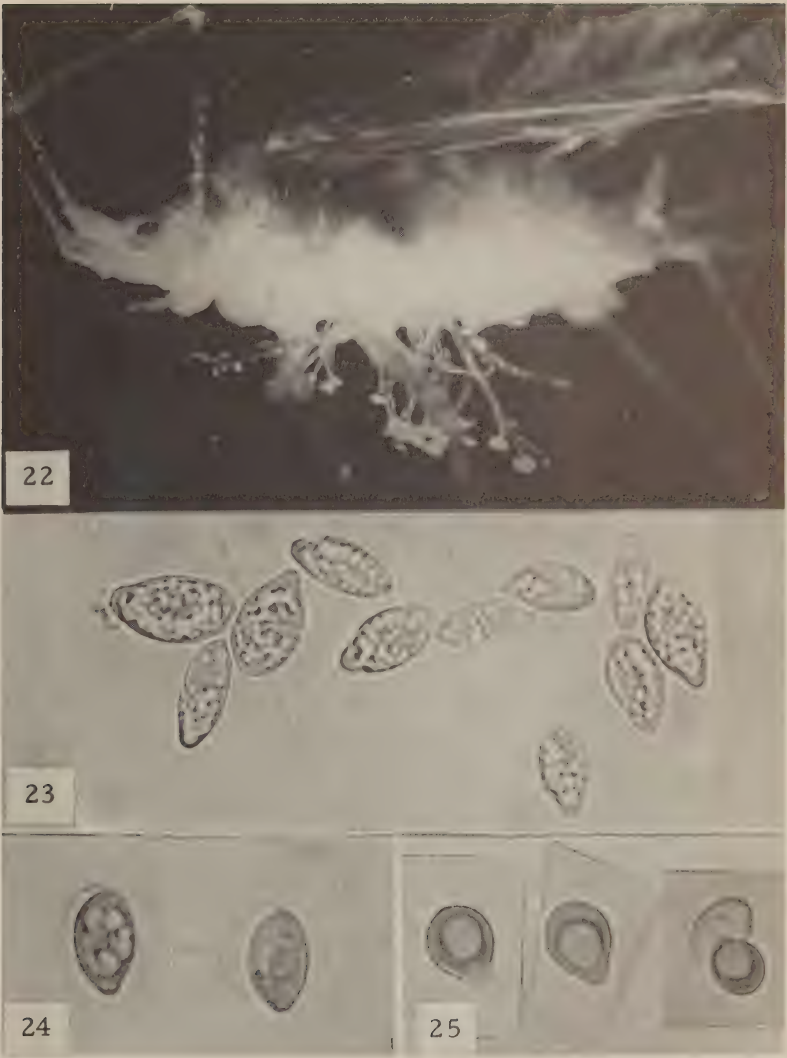


Fig. 22-25. *Erynia neoaphidis* sp. nov.; 22, rhizoïdes sur un ailé d'*Acyrthosiphon pisum* Harris infecté par la souche IPLB 1284; 23, conidies primaires ex culture IPLB 1284; 24, conidies primaires montrant la paroi bituniquée; 25, conidies secondaires subsphériques, pourvues d'un léger apicule.

TABLEAU 4

Mensurations (en µm) de conidies de *Erynia neoaphidis* sp. nov. projetées de pucerons (50 conidies mesurées par insecte)

	LONGUEUR			DIAMETRE			L/D		
	min	MOY	max	min	MOY	max	min	MOY	max
EUROPE: FRANCE									
1	22	26,8	32	10	12,2	15	1,7	2,21	2,8
2	16	25,1	30	9	12,7	16	1,6	1,99	2,4
3	23	31,9	40	12	14,0	16	1,6	2,29	2,9
4	15	24,0	30	10	12,2	15	1,5	1,97	2,3
5	16	23,7	28	10	11,3	13	1,4	2,10	2,5
6	22	25,3	28	12	13,4	15	1,6	1,88	2,3
7	20	24,1	30	11	12,1	14	1,6	2,00	2,6
AMERIQUE DU NORD: USA, MEXIQUE									
8	20	25,2	38	10	11,4	14	1,5	2,23	2,7
9	17	22,1	27	10	11,8	14	1,5	1,87	2,2
10	19	23,7	30	10	11,4	15	1,5	2,08	2,4
11	20	25,0	30	10	12,3	15	1,6	2,05	2,5
ASIE: TURQUIE, IRAN									
12	19	23,5	33	11	12,7	16	1,5	1,85	2,2
13	19	25,1	31	10	12,3	14	1,5	2,05	2,7
14	20	24,1	27	9	10,8	12	1,9	2,24	2,7
Moyennes:		22,1-31,9			10,8-14,0			1,85-2,29	

ORIGINE DES SPECIMENS

1 *Aphis rumicis* L. sur *Rumex acetosa*, Les Houches (Haute-Savoie, France) 21 VI 1976, Remaudière.

2 *Microlophium carnosum* Walker, sur *Urtica dioica*, Lac Vert (Haute-Savoie, France) 28 IX 1977, Remaudière.

3 *Wahlgreniella ossiannilssoni* Hille Ris Lambers, sur *Rosa alpina*, Lac Vert (Haute-Savoie,France) 28 VII 1977,Remaudière.

4 *Metopolophium dirhodum* Walker, sur *Triticum*, Coubert (Seine-et-Marne, France) 28 VII 1979, Remaudière.

5 *Metopolophium dirhodum* Walker, sur *Zea mays*, même localité.

6 *Microlophium carnosum* Walker, sur *Urtica dioica*, Quinéville (Manche, France) 27 XI 1977, Remaudière.

7 *Aphis ulicis* Walker, sur *Ulex europaeus*, Paimpol (Côtes-du-Nord, France) 26 VIII 1977, Remaudière.

8 *Macrosiphum gaurae*Willia, sur *Oenothera*, Chute-aux-Galets (Québec, Canada) 25 VIII 1976, Remaudière & Latgé.

9 *Nearctaphis bakeri* Cowen, sur *Trifolium*, Tuckerman's Ravine (New Hampshire, USA) 4 IX 1976, Remaudière & Latgé.

10 *Myzus persicae* Sulzer, sur ?, Xochimilco (Mexique, D.F.) 17 VIII 1978, Latgé.

11 Spécimen de même origine.

12 *Hyperomyzus lactucae* Mosley, sur *Sonchus*, Izmir (Turquie) 29 III 1979, Oncüer.

13 *Sitobion avenae* Fabricius, sur *Dactylis glomerata*, Tchalus (Iran)16 V 1977, Latgé.

14 *Aphis gossypii* Glover, sur *Ranunculus*, Pol-e-Karat (Iran) 19 V 1977, Latgé.

TABLEAU 5

Comparaison des dimensions moyennes (en µm) des conidies de "*E. aphidis*" sensu Nowak. et celles de notre matériel de *Erynia neoaphidis* sp. nov. (Tabl. 4), projetées d'insectes et de cultures (n = nombre de conidies mesurées) (les valeurs entre parenthèses correspondent à Lm/Dm estimé à partir des valeurs disponibles)

	LONGUEUR	DIAMETRE	L/Dmoy	n
ex INSECTES				
Nowakowski 1883	25,6	14,2	(1,8)	?
Thaxter 1888	25,0	12,0	(2,1)	?
Gustafsson 1965	21,0	11,0	(1,9)	?
Aruta & al. 1974	23,2	12,7	(1,8)	250
moyennes du Tabl. 4	22,1-31,9	10,8-14,0	1,85-2,29	14x50
moyennes générales	21,0-31,9	10,8-14,2	1,70-2,29	>1000
ex CULTURES				
5 souches Gustafsson	29,0-37,0	13,0-17,0	(1,6-2,2)	5x100
43 souches IPLB (orig.)	20,6-32,7	11,1-17,5	1,59-2,56	43x50
moyennes générales	20,6-37,0	11,1-17,5	1,59-2,56	2700

Remarques

Erynia neoaphidis correspond à l'espèce la plus fréquente dans les populations d'Aphides. A l'exception de *Entomophthora muscae* (Cohn) Fres. et peut-être de *E. grylli* Fres., Thaxter (1888) la considère comme la plus commune de toutes les Empusées. Pour chacune des 24 espèces d'*Entomophthora* qu'il a trouvées en Suède entre 1960 et 1963, Gustafsson (1965) donne le détail de ses récoltes; sa liste concernant "*E. aphidis*" est de loin la plus longue. Thoizon (1970) répertorie 95 espèces d'Aphides attaquées par cette Entomophthorale qu'elle a rencontrée dans 47 % de ses 191 lots de pucerons avec mycose provenant des diverses régions de France. Dans l'Est des USA et du Canada, Remaudière et al. (1978) constatent que "*E. aphidis*" est présent dans 82 % des échantillons comportant des cas de mycose et est responsable de la mort de 90 % des 696 pucerons dont l'agent de la mycose a été reconnu. Les prospections réalisées par Remaudière & Latgé en Iran et au Mexique (résultats non publiés) révèlent encore que *Erynia neoaphidis* est de très loin le principal pathogène des Aphides: l'espèce est représentée dans 81 % des échantillons avec mycose en Iran et 94 % au Mexique.

Erynia neoaphidis est l'une des espèces d'Entomophthorales les plus variables tant au point de vue morphologique que physiologique. La vitesse de croissance et les exigences nutritionnelles diffèrent considérablement d'une souche à l'autre mais ces différences ne sont pas liées à des particularités morphologiques. Certaines souches se développent bien sur milieu de Sabouraud tandis que d'autres exigent un enrichissement de ce milieu par du jaune d'oeuf (4 parties de Sabouraud pour une partie de jaune d'oeuf).

La caractérisation de *Erynia neoaphidis* devient difficile dès que l'on fait abstraction de la famille hôte (*Hom. Aphididae*) car la ressemblance est grande entre *Erynia neoaphidis*, *Entomophthora delphacis* Hori 1906, espèce à statut mal défini qui attaque au Japon *Nilaparvata lugens* Stål (*Hom. Delphacidae*) et *Erynia dipterigena* (Thaxter) comb. nov. qui est un pathogène commun sur des Diptères de diverses familles. Selon Shimazu (1976) les trois espèces pourraient être distinguées par leur spectre d'hôte et par les caractères de croissance sur milieu artificiel. Vu les différences considérables que nous constatons, non seulement dans la vitesse de croissance, mais aussi dans l'aspect de la culture des quelques centaines de souches de *E. neoaphidis* que nous avons isolées depuis 10 ans, les critères proposés par Shimazu ne nous paraissent pas satisfaisants.

Morphologiquement, les 3 espèces considérées présentent des conidies très semblables mais *Erynia dipterigena* peut être séparé par la présence de spores durables hyalines à diamètre de 20 à 40 µm et de formation externe; chez *Erynia neoaphidis* et *Entomophthora delphacis* les spores durables ne sont pas connues; les dimensions données par Shimazu pour les conidies de *Entomophthora delphacis* projetées d'insectes, (29,2)32,7(35,6) x (13,0)14,8(17,5) sont supérieures à celles de *Erynia neoaphidis* obtenues de pucerons, toutefois Shimazu précise que les conidies de *Entomophthora delphacis* projetées de cultures mesurent (22,9)30,2(36,8) x (12,4)15,5(20,3) µm, valeurs qui correspondent bien à celles des conidies de culture de *Erynia neoaphidis*.

Une souche de *Entomophthora delphacis* reçue de Shimazu (F 33) (N° IPLB 918) nous a donné à trois époques différentes des conidies dont les mesures soulignent l'extrême variabilité:

1) (22)27,6(31) x (13)16,2(19) µm; L/D (1,5)1,70(1,9)
2) (20)24,7(28) x (12)14,8(18) µm; L/D (1,4)1,67(1,9)
3) (19)22,8(25) x (11)12,6(15) µm; L/D (1,4)1,81(2,0)

En l'absence de matériel original, nous ne pouvons décider d'une éventuelle identité entre *Entomophthora delphacis* et *Erynia neoaphidis* et préférons considérer *E. delphacis* comme *nomen dubium*.

D. DESCRIPTION DE *ERYNIA NOURYI* SP. NOV.

Erynia nouryi sp. nov.
(= "*Entomophthora aphidis*" sensu Petch 1939)
(= "*Entomophthora exitialis*" sensu Gustafsson 1965)

Diagnose (latine et française) (Fig. 26-28).

Fungus entomogeneus (Entomophthoraceae). Conidiophori *ramosi, in sporodochia ad hospitem aggregata.* Primaria conidia *uninucleata, hyalina, ovoidea, axialiter symetrica, sparsim asymetrica, in apice rotunda, cum lata, brevi, rotundata vel applanata, pauce prominente, pariete ad conidii corporem continuo, papilla, in insectis (12)15,0-16,6(20)* x *(7)8,0-10,5(12) µm, in cultura (Gustafsson) (16)18(21)* x *(9)11(12) µm (ultima et media dimensio).* Secondaria conidia *ignota.* Perdurantes sporae *hyalinae in maturitate, cum laevi et crasso (3-4 µm) pariete, in massa albae, basim brevi crassotunicato parietis conidiophori segmento post ejectionem ornatae, in insectis (20)24,9-30,4(36) µm, in cultura (Gustafsson) (23)30(39) µm.* Hyphalia corpora *hyalina, varia, 90-180* x *6-10 µm, rigida vel curvata vel sinuosa, simplicia vel ramosa, cum granuloso cytoplasmate et 4-6 µm crassis nucleis.* Rhizoidea, *ut singula hypha, in conidia ferentibus hospitibus, non vero in perdurantes sporas continentibus hospitibus.* Hospes: Pemphigus bursarius *L.*, Aphis fabae *Scop.*, Aphis umbrella *Börner. In Anglia, Francia, Suecia, Palestina.* Holotypus: *in* Pemphigus bursarius *ad Cichorii intybus radices, Buchy, Francia, 10 jan. 1957, E. Noury (G. Remaudière n° 4003).*

Conidiophores ramifiés, apparaissant en petits coussinets (sporodochies) à la surface de l'hôte. *Conidies primaires* uninucléées, ovoïdes, à sommet arrondi, hyalines à symétrie axiale, rarement asymétriques avec une papille assez large, peu marquée, courte, faiblement arrondie à presque aplatie, en continuité du corps de la conidie; dimensions ex insectes: (12)15,0-16,6(20) x (7)8,0-10,5(12) µm, ex culture (Gustafsson 1965): (16)18(21) x (9)11(12) µm (Tableau 6). *Conidies secondaires* non observées (sans doute semblables aux primaires). *Spores durables* hyalines à maturité, à paroi épaisse (3 à 4 µm) et lisse donnant un aspect blanc laiteux à l'hôte plein de spores; point d'attachement de la spore à l'hyphe dont elle est issue marqué par court segment à membrane épaissie; diamètre ex insectes (20)24,9-30,4(36) µm; ex culture (Gustafsson 1965) (23)30(39) µm (Tableau 6). *Corps hyphaux* incolores, variables, 90-180 x 6-10 µm, droits, courbés ou sinués, simples ou ramifiés, à cytoplasme granuleux, à noyaux assez volumineux de 4-6 µm de diamètre. *Cystides* rares cylindriques à apex obtus, un peu plus épaisses que les conidiophores et mesurant environ 70-140 x 8-11 µm. *Rhizoïdes* monohyphaux, observés sur hôte porteur de conidies; les hôtes présentant des spores durables sont habituellement dépourvus de conidies et de rhizoïdes et sont fixés à la plante par les stylets du rostre.

Hôtes connus: *Pemphigus bursarius* L. (deux cas: Petch en Angleterre, Noury en France), *Aphis fabae* Scop. (un cas: Gustafsson en Suède), *Aphis umbrella* Börner (un cas, Kenneth en Israël) (*Hom. Aphididae*).

Distribution géographique: Angleterre, France (Normandie), Suède, Israël.

Holotype: échantillon recueilli par E. Noury (N° 489) ex *Pemphigus bursarius* L. sur racines de *Cichorium intybus* (endives) à Buchy, Seine-Maritime, France, le 10 I 1957 et enregistré sous le N° 4003 dans la collection d'Aphides G. Remaudière, Institut Pasteur, Paris. L'échantillon comporte 2 larves et un adulte aptère porteurs de spores durables

TABLEAU 6

Mensurations (en µm) de conidies et de spores durables de *Erynia nouryi* sp. nov., projetées d'insectes et de cultures (n = nombre de conidies ou spores durables mesurées) (les valeurs entre parenthèses sont estimées à partir des données disponibles).

	LONGUEUR			DIAMETRE			L/D			n
	min	MOY	max	min	MOY	max	min	MOY	max	
CONIDIES ex INSECTES										
1 Petch 1939	12	(15)	18	9	(10,5)	12				?
3a Noury (orig.)	13	16,6	20	8	9,1	11	1,4	1,84	2,4	32
4a Kenneth (orig.)	13	16,5	20	7	8,4	11	1,5	1,97	2,6	50
4b Kenneth (orig.)	14	16,6	19	7	8,0	9	1,7	2,08	2,5	50
Moyennes		15,0-16,6			8,0-10,5			1,8-2,1		>150
CONIDIES ex CULTURES										
2 Gustafsson 1965	16	18	21	9	11	12		(1,6)		?
SPORES DURABLES ex INSECTES										
1 Petch 1939				23	(27,5)	32				?
3b Noury (orig.)				23	28,8	33				50
3c Noury (orig.)				26	30,4	36				50
3d Noury (orig.)				26	30,3	36				50
4a Kenneth (orig.)				20	24,9	30				50
Moyennes					24,9-30,4					>200
SPORES DURABLES ex CULTURES										
2 Gustafsson 1965				23	30	39				?

ORIGINE DES SPECIMENS

1 *Pemphigus bursarius* L.(= *P. lactucarius* Passerini) sur *Lactuca* (Angleterre) IX 1937 (in Petch 1939).

2 *Aphis fabae* Scopoli, sur *Beta vulgaris*, Arlöw (Skåne, Suède) 21 VII 1960 (in Gustafsson 1965).

3 *Pemphigus bursarius* L., sur *Cichorium intybus* (endive), Buchy (Seine-Maritime, France) 10 I 1957 (E. Noury leg. 489); a, b, c, d, spécimens isotypes.

4 *Aphis umbrella* Börner, sur *Malva* (Israël) 8 I 1979 (Shiller & Kenneth leg.); a, individu portant à la fois des conidies et des spores durables jeunes; b, individu portant seulement des conidies; la même collection comporte également des spécimens présentant des conidies de *Erynia neoaphidis*.

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et une larve présentant des conidiophores et quelques conidies. Ces spécimens ont été conservés en alcool 22 ans et montés en 1979 dans le bleu trypan lactophénol. Une préparation isotype est déposée dans chacun des herbiers suivants: PC, K et FH.

Autres collections: Tableau 6.

Nous dédions cette espèce à la mémoire de E. Noury, naturaliste amateur qui a étudié avec passion les relations et les équilibres entre les peuplements végétaux et animaux de la Haute-Normandie.

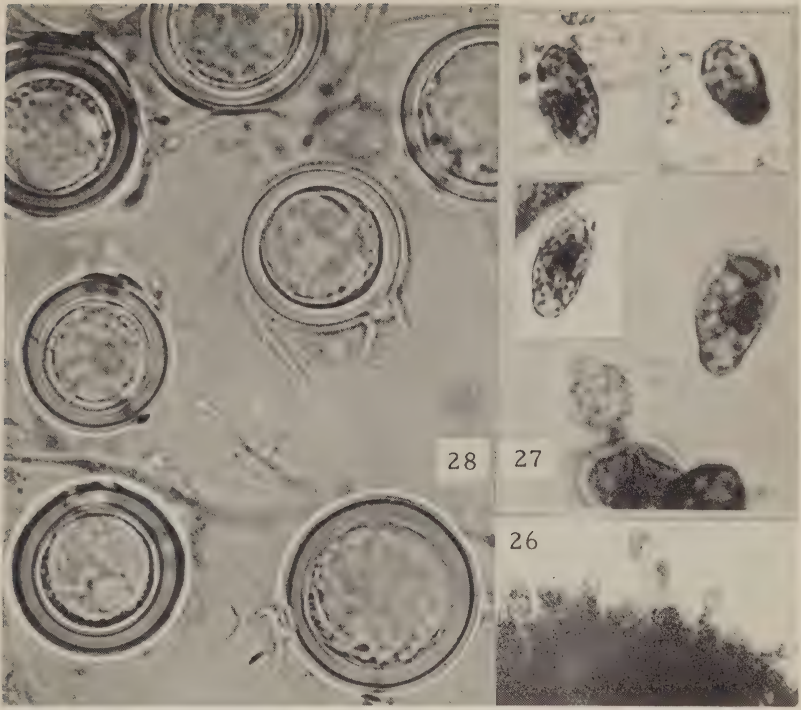

Fig. 26-28. *Erynia nouryi* sp. nov. ex *Pemphigus bursarius* L.; 26, conidiophores groupés en sporodochie portant de jeunes conidies; 27, conidies primaires; 28, spores durables mûres avec leur point d'attachement à l'hyphe.

Remarques:

Erynia nouryi est une espèce peu commune, surtout reconnaissable par ses conidies plus petites, à papille plus large et plus aplatie que celles de *E. neoaphidis* et par ses spores durables hyalines et lisses. La formation de ces spores durables n'a pas été observée. Il n'existe pas de culture de cette espèce qui a seulement été isolée une fois mais dont la souche a été détruite accidentellement (Gustafsson, 1965).

E. nouryi est une des rares espèces rencontrées dans les populations d'aphides radicicoles comme *Pemphigus bursarius* L.

Cette espèce est peut-être responsable des cas de mycose signalés sur *Pemphigus betae* Doane par Maxson (1916) au

Colorado, Charles (1941) en Californie et Harper (1958) en Alberta (Canada) et attribués à "*E. aphidis* Hoffm."

Aruta et al. (1974) ont signalé du Chili la présence de conidies et de spores durables de *Entomophthora aphidis* Hoffm. in Fres. dans les populations de 4 espèces de pucerons. Les dimensions données permettent de reconnaître les conidies de *Erynia neoaphidis*; en revanche les mensurations de spores durables, (25,8)29,4(33,1) µm, pourraient être celles de *E. nouryi* ou celles d'une autre espèce comme *Zoophthora radicans*.

Milner (1978), Milner & Teakle (1978) et Teakle (1978) ont observé en Australie sur 6 espèces d'Aphides (dont *Therioaphis trifolii* Monell, l'hôte original de *Entomophthora exitialis* Hall & Dunn) un agent de mycose qu'ils identifient provisoirement comme *Entomophthora* nr *exitialis*; occasionnellement, dans la nature, quelques individus ont été trouvés porteurs de spores durables petites (diamètre 20 µm). La souche EM 507 que ces auteurs ont isolée et nous ont transmise (IPLB 1172) représente typiquement *Erynia neoaphidis*; comme nos autres souches de cette espèce, elle ne donne pas de spores durables. Les spores durables constatées en Australie ne sont pas actuellement identifiables.

E. COMPARAISON DES TROIS ESPECES ETUDIEES

Le diagramme (Fig. 29) permet de comparer la forme et les dimensions des conidies primaires de *Zoophthora aphidis*, *Erynia neoaphidis* et *Erynia nouryi*, à la fois sur pucerons et en culture, sur la base des données déjà mentionnées pour chaque espèce.

Sur insectes, on constate la nette distinction des trois espèces: *Z. aphidis* présente les rapports L/D les plus élevés, *E. nouryi* présente les dimensions les plus faibles. En culture *E. neoaphidis* montre une grande variabilité.

En résumé nous reconnaissons:

Zoophthora aphidis (Hoffm. in Fres.) Batko, par la présence de capilloconidies, par des conidies primaires de longueur moyenne supérieure à 26 µm avec un rapport L/D moyen supérieur à 2,4 et par de grandes spores durables pigmentées; il est spécifique d'*Anoecia*.

Erynia neoaphidis sp. nov., par l'absence de capilloconidies, par des conidies primaires de longueur moyenne supérieure à 20 µm avec un rapport L/D moyen compris entre 1,7 et 2,6 et jusqu'à présent par l'absence de spores durables; il attaque la plupart des aphides.

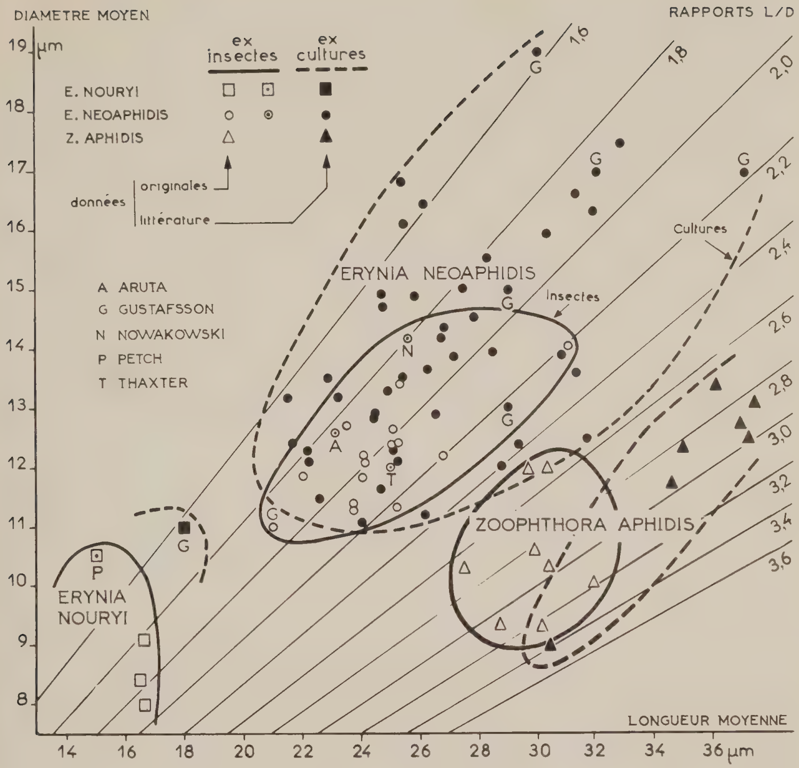

Fig. 29. Comparaison des dimensions conidiennes de *Zoophthora aphidis* (Hoffm. in Fres.) Batko, *Erynia neoaphidis* sp. nov. et *Erynia nouryi* sp. nov. (conidies de pucerons et de cultures).

Erynia nouryi sp. nov., par l'absence de capilloconidies, par des conidies primaires petites, de longueur moyenne inférieure à 18 µm et de rapport L/D moyen variant de 1,4 à 2,4 et par la présence de spores durables hyalines de dimension moyenne; il n'est connu que sur quelques aphides et en particulier sur les *Pemphigus* radicicoles.

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MYCOTAXON

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NOTICE

SOLHEIM MYCOLOGICAL HERBARIUM ESTABLISHED

A new mycological herbarium has been established within the Department of Botany at the University of Wyoming. The Wilhelm G. Solheim Mycological Herbarium, consisting of over 50,000 fungal specimens, commemorates 50 years of work by the late Professor Emeritus of Botany and his wife, Ranghild.

The herbarium is rich in material collected throughout the Rocky Mountain region and contains, as well, considerable exchange material acquired from elsewhere in North and South America, Europe, and Asia. Parasitic fungi are especially well-represented.

Housed in the Aven Nelson Memorial Building, along with Dr. Solheim's personal mycological library, the collection is available for study by qualified students and researchers. Specimens may be borrowed by recognized institutions for one year. Additionally, some duplicates from Centa IV - XVII of **Mycoflora Saximontanensis Exsiccata** are available for exchange.

To encourage graduate studies in mycology, a memorial scholarship has also been established at the University in honor of Dr. Solheim.

Inquiries concerning the herbarium should be addressed to: The Curator, W. G. Solheim Mycological Herbarium, Department of Botany, University of Wyoming, Laramie, WY 82071 U.S.A.

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REVISION SYSTEMATIQUE DES GENRES D'ENTOMOPHTHORACEAE A POTENTIALITE ENTOMOPATHOGENE

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RESUME

Les défauts de la classification de MacLeod (1963) et de celle proposée par Batko (1964-1966) pour les *Entomophthoraceae* entomopathogènes sont discutés, ainsi que le poids relatif qu'il convient d'attacher aux différents caractères. Les changements apportés par rapport à la classification de Batko sont les suivants: inclusion de *Entomophaga* Batko dans le genre *Conidiobolus* Bref., inclusion de *Culicicola* Nieuwl. dans le genre *Entomophthora* Fres., remplacement de *Triplosporium* (Thaxter) Batko par *Neozygites* Witl., prioritaire, acceptation des genres *Zoophthora* Batko et *Erynia* Nowak. dans le sens de Remaudière & Hennebert (1980), classement de *Strongwellsea* Batko & Weiser comme synonyme de *Erynia* Nowak., traitement de *Tarichium* Cohn comme *genus incertae sedis*. Une diagnose des genres est donnée, ainsi que les nouvelles combinaisons impliquées par les modifications proposées.

ZUSAMMENFASSUNG

Die Klassifikationen der insektenpathogenen *Entomophthoraceae*, wie die von MacLeod (1963) und von Batko (1964-1966) vorgeschlagen werden, beinhalten Mängel, auf die hingewiesen wird. Nach einer Diskussion der Eignung verschiedener Merkmale als Gattungskriterien werden folgende Anderungen der Klassifikation von Batko vorgeschlagen: Eingliederung von *Entomophaga* Batko in die Gattung *Conidiobolus* Bref., Eingliederung von *Culicicola* Nieuwl. in die Gattung *Entomophthora* Fres., Ersetzung von *Triplosporium* (Thaxter) Batko durch *Neozygites* Witl. aus Prioritätsgründen, Anerkennung der Gattungen *Zoophthora* Batko und *Erynia* Nowak.im Sinne von Remaudière & Hennebert (1980), Betrachtung von

Strongwellsea Batko & Weiser als Synonym von *Erynia* Nowak., sowie Behandlung von *Tarichium* Cohn als *genus incertae sedis*. Die Gattungsdiagnosen werden angeführt wie auch die Neukombinationen, die sich aus den vorgeschlagenen Modifikationen ergeben.

ABSTRACT

The deficiencies in the classification of MacLeod (1963) and that proposed by Batko (1964-1966) for the entomopathogenic *Entomophthoraceae* are discussed, along with the suitable relative weights attached to different characters. The changes brought to bear on the classification of Batko are the following: the inclusion of *Entomophaga* Batko into the genus *Conidiobolus* Bref.; the inclusion of *Culicicola* Nieuwl. into the genus *Entomophthora* Fres.; the replacement of *Triplosporium* (Thaxter) Batko with the genus *Neozygites* Witl., by priority; the acceptance of the genera *Zoophthora* Batko and *Erynia* Nowak. in the view of Remaudière & Hennebert (1980); the classing of *Strongwellsea* Batko & Weiser as synonym of *Erynia* Nowak.; the treatment of *Tarichium* Cohn as *genus incertae sedis*. A diagnosis of these genera is given along with new combinations implicated by the proposed modifications.

1. INTRODUCTION

La famille des *Entomophthoraceae* est remarquable par la diversité écologique de ses représentants: à côté d'espèces saprophytes, on trouve en effet des pathogènes d'algues, de fougères, de nématodes, de tardigrades, d'arachnides, d'insectes et, occasionnellement, de vertébrés.

Nous limitons la présente révision aux seuls genres qui comprennent des espèces entomopathogènes.

Depuis la création, en 1855, du premier genre de la famille, *Empusa* Cohn, la classification a subi beaucoup d'aléas et demeure controversée. Deux tendances s'opposent aujourd'hui: MacLeod (1963), suivi par de nombreux auteurs, réunit dans le genre *Entomophthora* Fres. la plupart des espèces entomopathogènes, tandis que Batko (1964a,b,c,d et 1966) répartit ces espèces dans 5 genres et 4 sous-genres.

Le défaut majeur de chacune de ces positions est de ne pas tenir compte du genre *Conidiobolus* Bref. qui était appliqué à des espèces de *Entomophthoraceae* saprophytes. La reconnaissance des potentialités entomopathogènes de certains *Conidiobolus* comme *C. osmodes* Drechsler (Remaudière & al. 1976), le transfert dans *Conidiobolus* d'espèces classées auparavant dans *Entomophthora* comme *C. coronatus* (Cost.)Batko, *C. pseudococci* (Speare) Tyrr. & MacLeod, la démonstration de la synonymie *C. thromboides* Drechsler = *E. virulenta* Hall & Dunn (Latgé et al. 1980) montrent l'inconsistance du critère biologique "saprophyte/pathogène" utilisé auparavant pour séparer *Conidiobolus* et *Entomophthora* sensu lato. La classification de Batko n'a pas levé cette difficulté, la frontière entre les genres *Entomophaga* Batko et *Conidiobolus* n'étant pas délimitée.

Si la tentative méritoire de clarification de la systématique des Entomophthoracées entomopathogènes entreprise par Batko a été fort peu suivie par les auteurs, nous estimons

que cela est dû essentiellement aux deux raisons suivantes:
- l'absence de critères morphologiques sur lesquels pourrait être fondée la séparation des genres *Conidiobolus* et *Entomophaga*
- le poids, à notre avis excessif, donné à certains caractères comme les rhizoïdes et les cystides, qui a conduit Batko à réunir dans certains genres des espèces dépourvues d'affinités et à séparer 4 sous-genres sur des bases fragiles.

Le genre *Zoophthora* Batko ayant été révisé par Remaudière & Hennebert (1980), nous proposons, après une brève analyse historique, une classification plus cohérente des autres genres de *Entomophthoraceae* à potentialité entomopathogène.

2. APERÇU HISTORIQUE

L'histoire de la classification des *Entomophthoraceae* a été retracée par différents auteurs (MacLeod 1963, Güstafsson 1965, Remaudière & Hennebert 1980). Une confusion nomenclaturale a été créée par la persistance de l'utilisation du nom *Empusa* Cohn 1855, pourtant reconnu illégitime par Fresenius et remplacé par *Entomophthora* Fres. 1856.

Cette confusion a été aggravée lorsque Nowakowski (1883) a donné une application différente à ces deux noms synonymes. Cet auteur admet alors 4 genres caractérisés de la façon suivante:
- *Empusa* Cohn 1855, à conidiophores simples et dépourvu de rhizoïdes,
- "*Entomophthora* Fres. 1856" sensu Nowak., à conidiophores ramifiés et pourvu de rhizoïdes,
- *Lamia* Nowak. 1883, à conidiophores simples et rhizoïdes,
- *Tarichium* Cohn 1870 qui réunit les espèces dont seules les spores durables sont connues.

Nowakowski rejette son genre *Erynia* Nowak. 1881 comme synonyme de "*Entomophthora*"

Thaxter (1888) retient *Empusa* avec *Lamia* comme synonyme, "*Entomophthora*" comme sous-genre et crée un deuxième sous-genre, *Triplosporium* Thaxter 1888 caractérisé par des conidies primaires subhyalines ou fuligineuses, un type particulier de capilloconidies et la formation de zygospores par isogamie. Il cite aussi le genre *Massospora* Peck 1879.

En 1916, Nieuwland remplace *Lamia* Nowak., préoccupé, par le nouveau nom *Culicicola* Nieuwl. 1916.

Après Hall & Bell (1962), MacLeod (1963) confirme l'illégitimité de *Empusa* Cohn et ne reconnaît que deux genres entomopathogènes: *Entomophthora* et *Massospora*. Il est suivi par la majorité des auteurs postérieurs et en particulier par Waterhouse (1973) qui rejette les genres retenus ou créés par Batko au rang de synonymes de *Entomophthora* Fres.

La classification élaborée par Batko (1964a,b,c,d) représentait pourtant une tentative intéressante de clarification. La clé suivante indique schématiquement les caractères permettant de séparer les 5 genres considérés par

Batko: *Entomophthora* Fres. 1856, *Triplosporium* (Thaxter 1888) Batko 1964, *Culicicola* Nieuwl. 1916 (= *Lamia* Nowak. 1883), *Zoophthora* Batko 1964, *Entomophaga* Batko 1964.

1- Conidiophores simples, conidies plurinucléées, à paroi simple. 2
 - Conidiophores ramifiés, conidies uninucléées, à paroi double, rhizoïdes toujours présents . . . . *Zoophthora*

2- Rhizoïdes présents. . . . . *Culicicola*
 - Rhizoïdes absents 3

3- Conidies primaires à 4 noyaux, à papille tronquée, présence de capilloconidies, zygospores formées par isogamie . . . . *Triplosporium*
 - Conidies primaires ayant au moins une dizaine de noyaux, capilloconidies absentes. 4

4- Conidies primaires campanulées, à apex pointu, à base tronquée, comportant 10-12 noyaux. . . . . . *Entomophthora*
 - Conidies primaires sphériques à pyriformes, à apex arrondi, à papille arrondie, à très nombreux petits noyaux . . . . *Entomophaga*

Batko & Weiser (1965) créent le nouveau genre *Strongwelsea*, proche de *Zoophthora* mais dépourvu de rhizoïdes et à conidiophores seulement exceptionnellement ramifiés. Le genre est surtout remarquable par le mode d'adaptation à son hôte qui survit à l'infection et participe activement à la dispersion des conidies projetées de son abdomen.

En 1966, Batko scinde son genre *Zoophthora* en 4 sous-genres (*Zoophthora* Batko 1964 sensu stricto, *Erynia* Nowak. 1881, *Pandora* Batko 1966 et *Furia* Batko 1966) qu'il caractérise sur des bases subtiles telles que l'aspect des conidies primaires, des cystides, des rhizoïdes et sur l'aptitude à donner des capilloconidies.

Ayant redécouvert *Entomophthora aphidis* Hoffm. in Fres. 1858, espèce proche de *Zoophthora radicans* (Bref.) Batko (type de *Zoophthora* Batko 1964), Remaudière & Hennebert (1980) ont montré que la diagnose du sous-genre *Pandora* Batko 1966 ne correspond pas à *Entomophthora aphidis* Hoffm. in Fres., son espèce type, mais à une espèce bien différente "*Entomophthora aphidis*" sensu Nowak. 1883. Ils limitent l'application du genre *Zoophthora* Batko à son seul sous-genre *Zoophthora*, avec *Pandora* comme synonyme et rétablissant *Erynia* Nowak. 1881 au rang de genre avec *Furia* comme synonyme.

Un dernier genre, *Tarichium* Cohn 1870, dans lequel sont rassemblées les espèces dont seules les spores durables sont connues, est considéré par Lakon (1915) comme "Hilfsgattung". Il est encore rencontré dans la littérature récente; MacLeod & Müller-Kögler (1970) utilisent le terme *Entomophthora (Tarichium)* pour ces espèces, sans lui donner la signification d'une division subgénérique au sens du Code international de Nomenclature Botanique (Lanjouw et al. 1966).

En 1970, von Arx propose une classification très particulière des Entomophthoracées; à côté du genre *Conidiobolus* qu'il sépare comme non entomopathogène, il retient deux genres (1) *Entomophthora* Fres. 1856 qu'il typifie par *E. sphaerosperma* Fres. et caractérise par des conidies pyriformes ou ellipsoïdales (2) *Myiophyton* Lebert 1856 (!) avec pour basionyme *Empusa muscae* Cohn dans lequel il réunit les espèces à conidies campanulées.

3. CRITIQUE DES CLASSIFICATIONS ANTERIEURES

Rejoignant les conceptions des anciens auteurs qui ont tenté de séparer les *Entomophthoraceae* entomopathogènes en plusieurs groupes de rang générique ou subgénérique (Nowakowski 1881, 1883, Thaxter 1888), nous considérons que le genre *Entomophthora* pris dans le sens que lui appliquent MacLeod (1963), Gustafsson (1965) et Waterhouse (1973) est beaucoup trop hétérogène pour être conservé indivis.

La classification proposée par Batko (1964a,b,c, 1966) et Batko & Weiser (1965), compte tenu des modifications déjà apportées par Remaudière & Hennebert (1980), pour le genre *Zoophthora*, comporte encore un certain nombre d'imperfections:

1- Les espèces à conidies campanulées sont réparties dans 2 genres, *Entomophthora* et *Culicicola*, sur le seul critère absence ou présence de rhizoïdes.

2- De même les espèces à conidies sphériques multinucléées sont réparties dans les genres *Entomophaga* et *Culicicola* sur la base du même critère.

3- Conséquemment, le genre *Culicicola* réunit d'une façon artificielle des espèces à conidies campanulées, paucinucléées et à papille aplatie, et des espèces à conidies sphériques, multinucléées et à papille arrondie, ceci sur la base de l'unique caractère commun à ces deux groupes, la présence de rhizoïdes. Batko & Weiser (1965, tableau 1) ont tenté de corriger cette anomalie en adjoignant au genre *Entomophaga* le sous-genre nouveau "*Lichia* Weiser & Batko 1965", caractérisé par l'existence de rhizoïdes et de conidies à plus de 20 noyaux et en précisant que *Culicicola* a des conidies à 1-4 noyaux. Comme le sous-genre "*Lichia*" n'a jamais été décrit ni typifié, nous devons le rejeter comme *nomen nudum*.

4- La frontière entre *Entomophaga* et *Conidiobolus* n'est pas délimitée bien qu'une tentative de distinction des 2 genres soit esquissée dans le tableau 1 de Batko & Weiser (1965) mais non explicitée dans le texte: "resting spores in rel. to sporangium" internes chez *Conidiobolus*, externes chez *Entomophaga*, comme chez les autres genres entomopathogènes. L'utilisation d'un tel critère, s'il était justifié aurait l'inconvénient d'impliquer la création d'un nouveau groupe à position incertaine pour l'ensemble des espèces de *Conidiobolus* et d' *Entomophaga* dont les spores durables ne sont pas connues.

5- Le genre *Strongwellsea* Batko & Weiser est séparable de *Zoophthora* sensu Batko (= *Zoophthora* + *Erynia* sensu

Remaud. & Henn.) seulement par des caractères de faible poids: le caractère conidiophores ramifiés n'est pas toujours évident, le caractère rhizoïdes et cystides n'est pas constaté chez certaines espèces de *Zoophthora* et de *Erynia*. La particularité essentielle du genre, selon ses auteurs, est de représenter un cas d'adaptation d'un degré inhabituellement élevé du parasite à son insecte hôte, beaucoup plus élevé que dans le genre *Massospora* Peck, au point de représenter l'unique *Entomophthoraceae* non létale. Le genre *Strongwellsea* semble donc établi davantage sur une base clinique, symptomatique et écopathologique que sur une base morphologique classique. En réalité, hormis les *Massospora*, des comportements semblables ont été signalés chez au moins quatre espèces appartenant à deux genres bien distincts: *Entomophthora erupta* Dustan, *E. thripidum* Samson et al., *E. weberi* Lakon ex Samson et *Entomophaga kansana* (Hutchison) Batko. Keller (non publié) observant récemment une épizootie de *E. erupta* sur le *Miridae Notostira elongata* constate que, contrairement aux observations de Dustan (1924), les hôtes meurent avant l'apparition des conidies. Ces différents types de comportement sont l'expression de l'interaction hôte/parasite et non une propriété intrinsèque du champignon. A notre avis, ils ne peuvent être retenus comme critères de distinction générique.

La classification proposée par von Arx (1970) est inacceptable: (1) *Entomophthora* Fres. 1856 nom. nov. pour *Empusa* Cohn 1855, illégitime, a obligatoirement pour type *Empusa muscae* Cohn; la désignation de *Entomophthora sphaerosperma* Fres. comme type de *Entomophthora* Fres. doit être rejetée car contraire à l'article 7 du Code International de Nomenclature Botanique (Stafleu, 1972). (2) *Myiophyton* Lebert a été publié en 1857 et non en 1856 et est un synonyme postérieur de *Entomophthora* Fres. 1856.

4. MODIFICATIONS TAXONOMIQUES ET NOMENCLATURALES PROPOSEES

a) REMARQUES SUR LE POIDS RELATIF ATTACHE A DIFFERENTS CARACTERES

Une classification doit être basée sur un ensemble de critères morphologiques stables et bien définis, indépendants des conditions de l'environnement. Les caractères de comportement ne peuvent être retenus que dans la mesure où ils sont liés à des structures particulières de l'organisme à classer et non pas à des réactions particulières de son hôte.

Suivant Nowakowski (1883) et Lakon (1919, 1962), Batko a accordé un poids excessif au caractère présence/absence de rhizoïdes. Le développement des rhizoïdes, chez certaines espèces, est en effet lié à une série de facteurs écologiques (nécessité de la présence d'eau liquide en contact de l'hôte, chez *Zoophthora aphidis* (Hoffm. in Fres.) Batko par exemple) ou de facteurs physiologiques (constance des rhizoïdes chez les cadavres d'aphides projetant des conidies de *Entomophthora planchoniana* Cornu, inconstance des rhizoïdes chez ceux contenant les spores durables de la même espèce). L'aptitude à développer des rhizoïdes ne peut être retenue comme caractère d'importance générique car elle obligerait à classer dans des genres distincts des espèces très voisines.

La nature et le mode de formation des spores durables ne peut pas non plus être retenu comme critère primordial d'une classification des *Entomophthoraceae.* Indépendemment du fait que les spores durables ne sont pas connues (ou n'existent pas) chez une série d'espèces et que les conditions de formation des spores durables demeurent inconnues dans beaucoup de cas, les connaissances acquises à ce jour indiquent que différents modes de reproduction sexuée ou asexuée coexistent dans les groupes d'espèces les plus homogènes.

Ainsi les caractères fondamentaux qui peuvent être retenus aujourd'hui sont la morphologie des conidies primaires et secondaires, le mode de leur formation et de leur libération. C'est d'ailleurs sur ces bases que Gustafsson (1965), Waterhouse (1975) et Zimmerman (1978) ont déjà distingué des groupes d'espèces dans le genre *Entomophthora* Fres. pris au sens large.

b) MODIFICATIONS PROPOSEES

Les modifications que nous proposons ont essentiellement pour objet de remédier aux principales imperfections relevées dans la classification de Batko. Compte tenu de la récente révision des genres *Zoophthora* Batko et *Erynia* Nowak. par Remaudière & Hennebert (1980), il nous paraît nécessaire:

(1) d'inclure dans le genre *Conidiobolus* Bref. les espèces du genre *Entomophaga* Batko ainsi que les espèces à conidies sphériques et multinucléées classées par Batko dans *Culicicola* Nieuwl.;

(2) de réunir dans le genre *Entomophthora* toutes les espèces à conidies campanulées, paucinucléées, y compris *Culicicola culicis* (A. Braun) Nieuwl.; ainsi *Culicicola* Nieuwl. devient synonyme de *Entomophthora* Fres., vu l'inclusion de son espèce type *C. culicis*;

(3) de traiter le genre *Strongwellsea* Batko & Weiser comme synonyme de *Erynia* Nowak.

Du point de vue nomenclatural, il convient de remplacer le nom générique *Triplosporium* Thaxter 1888 par *Neozygites* Witlaczil 1885. Giard (1889) a montré que *Neozygites aphidis* Witl., décrit comme une Grégarine, était en fait une Entomophthorée; en comparant les figures 128-140 de Thaxter illustrant la formation des zygospores de *Triplosporium fresenii* Nowak., avec les figures 1 à 13 de Witlaczil, il conclut à l'identité générique du *Triplosporium* et du *Neozygites.* Comme *T. fresenii* Nowak. 1883 est la seule espèce du genre fréquente sur Aphides (*T. lageniformis* Thaxter a été rarement observé, ses spores ne sont pas connues), nous devons reconnaître que *Neozygites aphidis*, découvert sur *Hyalopterus pruni* Geoff. (= *H. arundinis* auctt.), est un synonyme de *T. fresenii*. Gustafsson (1965) avait adopté la même position qui est d'ailleurs rappelée par Waterhouse (1973).

Le genre *Tarichium* Cohn 1870 (espèce type *T. megaspermum* Cohn 1870) est un genre basé sur une espèce incomplètement connue donc de position incertaine. Comme il n'est pas possible de rattacher *Tarichium* à l'un des genres de *Entomophthoraceae* que nous acceptons aujourd'hui, il convient de traiter *Tarichium* comme *genus incertae sedis* et toutes les espèces qui y sont habituellement classées, comme *species incertae sedis*.

En conclusion nous retenons les 6 genres suivants: *Conidiobolus* Bref. 1884, *Neozygites* Witl. 1885, *Entomophthora* Fres. 1856, *Erynia* Nowak. 1881, *Zoophthora* Batko 1964, *Massospora* Peck 1879.

5. CARACTERISATION DES GENRES RETENUS

Genre *CONIDIOBOLUS* Brefeld 1884 (*Untersuch. aus d. Gesammtgeb. d. Mykol. Leipzig, H6*: 35-78).
Espèce type: *Conidiobolus utriculosus* Bref. 1884 (*loc. cit.* p. 37)
= *Entomophaga* Batko 1964, syn. nov. (*Bull. Acad. Polon. Sci., cl. II, ser. Sci. Biol. 12*: 325-326); espèce type: *Entomophthora grylli* Fres. 1856 (*Bot. Zeitg. 14*: 883) ≡ *Conidiobolus grylli*.

Diagnose:

Conidiophores simples, renflés ou non. *Conidies primaires* sphériques, subsphériques à pyriformes, à symétrie axiale, apex toujours arrondi; papille basale conique à arrondie, parfois pointue ou apiculée, sans épaulement; paroi unituniquée, lisse; noyaux souvent très nombreux (5)25-50(100) et petits; éjectées par projection violente à 1-3 cm. *Conidies secondaires* pouvant correspondre à certains des 4 types suivants (a) semblables aux primaires (b) microconidies en couronne autour des primaires (c) conidies fusiformes ou ellipsoïdales éjectées comme les primaires (d) capilloconidies allongées à symétrie axiale; à apex arrondi, détachables passivement. *Spores durables* pouvant correspondre à l'un des trois types suivants: zygospores formées par anisogamie, azygospores, spores villeuses, inconnues chez certaines espèces; sphériques, hyalines ou plus ou moins brunes, à épispore lisse ondulée ou cannelée. *Cystides* rarement présentes. *Rhizoïdes* parfois présents.

Espèces saprophytes ou/et pathogènes d'insectes et arachnides, occasionnellement de vertébrés. Culture généralement peu exigeante à croissance rapide.

Nouvelles espèces incluses dans le genre:

C. apiculatus (Thaxter 1888) comb. nov. ≡ *Empusa apiculata* Thaxter 1888 (*Mem. Boston Soc. nat. Hist. 4*: 163-164, fig. 62-75).
C. batkoi (Bałazy 1978) comb. nov. ≡ *Entomophthora batkoi* Bałazy 1978 (*J. Invertebrate Pathol. 31*: 278-279, fig. 1-3).
C. carpentieri (Giard 1888) comb. nov. ≡ *Entomophthora carpentieri* Giard 1888 (*Bull. Sci. Fr. Belg. 19*: 303-304).
C. conglomeratus (Sorokin 1877) comb. nov. ≡ *Entomophthora conglomerata* Sorokin 1877 (*Cohn Beitr. Biol. Pflanz. 2*: 388-393, fig. 1-11).

C. giganteus (Keller 1978) comb. nov. ≡ *Entomophthora gigantea* Keller 1978 (*Sydowia, Ann. Mycol. Ser II, 31*: 89-92, fig. 6-19).

C. grylli (Fresenius 1856) comb. nov. (*loc. cit.*).

C. major (Thaxter 1888) comb. nov. ≡ *Empusa apiculata* var. *major* Thaxter 1888 (*Mem. Boston Soc. nat. Hist. 4*: 164-165, fig. 71-73).

C. obscurus (Hall & Dunn 1957) comb. nov. ≡ *Entomophthora obscura* Hall & Dunn 1957 (*Hilgardia 27*: 162-163, fig. 4-5).

C. papillatus (Thaxter 1888) comb. nov. ≡ *Empusa papillata* Thaxter 1888 (*Mem. Boston Soc. nat. Hist. 4*: 166-167, fig. 82-90).

C. tenthredinis (Fresenius 1858) comb. nov. ≡ *Entomophthora tenthredinis* Fresenius 1858 (*Abhandl. Senckenb. Naturf. Ges. Frankfurt a.M. 2*: 205, fig. 51-58).

C. tipulae (Fresenius 1858) comb. nov. ≡ *Entomophthora tipulae* Fresenius 1858 (*Abhandl. Senckenb. Naturf. Ges. Frankfurt a.M. 2*: 206, fig. 46-50).

27 autres espèces de ce genre sont citées et redécrites par King (1977).

Genre NEOZYGITES Witlaczil 1885 (*Arch. f. Mikr. Anat. 24*: 599-603).

Espèce type: *Neozygites aphidis* Witl. 1885 (*loc. cit.*) = *Neozygites fresenii*.

= *Empusa* subg. *Triplosporium* Thaxter 1888 syn. nov. (*Mem. Boston Soc. nat. Hist. 4*: 152); espèce type: *Empusa fresenii* Nowak. 1883 (*Pamietn. Wydz. Akad. Umiej. w. Kraków 8*: 17-172) ≡ *Neozygites fresenii*.

  ≡ *Triplosporium* (Thaxter) Batko 1964 syn. nov. (*Bull. Acad. Polon. Sci., cl II, Ser. Biol. 12*: 324-325); espèce type: *Empusa fresenii* Nowak. 1883 (*loc. cit.*) ≡ *Neozygites fresenii*.

Diagnose

Conidiophores simples. *Conidies primaires* en forme de montgolfière, sphériques à pyriformes, à symétrie axiale, apex toujours arrondi; papille basale courtement cylindrique tronquée, sans épaulement; paroi unituniquée, lisse, un peu sombre; généralement 4 noyaux; éjectées par projection à faible distance. *Conidies secondaires* pouvant correspondre aux deux types suivants (a) semblables aux primaires (b) capilloconidies amygdaliformes à symétrie bilatérale, avec une partie basale largement arrondie et une partie apicale subconique surmontée d'un disque ou d'une gouttelette adhésive, à paroi un peu épaissie, légèrement pigmentée, détachables passivement. *Spores durables* correspondant à l'un des deux types suivants: soit zygospores formées par isogamie, soit azygospores; inconnues chez certaines espèces; ovoïdes à subsphériques avec point d'attachement généralement marqué par un fragment hyphal; brunes à noires, à épispore lisse ou ridée. *Cystides* et *rhizoïdes* toujours absents.

Espèces pathogènes d'acariens et d'insectes *Homoptera* et *Thysanoptera*. Apparemment jamais cultivé.

Principales espèces du genre:

N. adjarica (Tsintsadze & Vartapetov 1976) comb. nov. ≡ *Entomophthora adjarica* Tsintsadze & Vartapetov 1976 (*Bull. Acad. Sci. Georgian SSR 83*: 465-468).

N. floridana (Weiser & Muma 1966) comb. nov. ≡ *Entomophthora floridana* Weiser & Muma 1966 (*Florida Ent. 49*: 155-157, fig. 1-3).

N. fresenii (Nowak. 1883) comb. nov. (*loc. cit*).
N. fumosa (Speare 1922) comb. nov. ≡ *Empusa fumosa* Speare 1922 (*U.S. Dept. Agr. Bull. 1117*: 1-18).
N. lageniformis (Thaxter 1888) comb. nov. ≡ *Empusa lageniformis* Thaxter 1888 (*Mem. Boston Soc. Nat. Hist. 4*: 169, fig. 141-160).
N. parvispora (MacLeod & Carl in MacLeod et al. 1976) comb. nov. ≡ *Entomophthora parvispora* MacLeod & Carl in MacLeod et al. 1976 (*Entomophaga 21*: 307-312, fig. 1-19).
N. tetranychi (Weiser 1968) comb. nov. ≡ *Triplosporium tetranychi* Weiser 1968 (*Fol. parasitol. Praha 15*: 117-121, fig. 1-3).
N. turbinata (Kenneth 1977) comb. nov. ≡ *Entomophthora turbinata* Kenneth 1977 (*Mycotaxon 6*: 388, fig. 1-8).

Genre ENTOMOPHTHORA Fresenius 1856 (*Bot. Zeitg. 14*: 883).
Espèce type: *Empusa muscae* Cohn 1855 (*Hedwigia 1*: 60) ≡ *Entomophthora muscae*.
≡ *Empusa* Cohn 1855 (*loc. cit.*) non Lindley 1824 (*Orchidaceae*); espèce type: *Empusa muscae* Cohn 1855 (*loc. cit.*) ≡ *Entomophthora muscae*.
≡ *Myiophyton* Lebert 1857 (*Neue Denkschr. allg. Schweiz. Ges. gesammt. Naturwiss. 15*: 26); espèce type: *Myiophyton cohni* Lebert 1857 (*loc. cit.*) ≡ *Empusa muscae* Cohn 1855 ≡ *Entomophthora muscae*.
= *Lamia* Nowak. 1883 (*Pamietn. Wydz. Akad. Umiej. w. Kraków 8*: 173-174) non Endlicher 1841, non *Lamium* Linn.(*Labiatae*); espèce type: *Lamia culicis* A. Braun 1855 (*Alg. unicell. gen. nov. et min. cogn. praem. obs. de algis unicell. in gen., W. Engelmann, Lipsiae*: 105) ≡ *Entomophthora culicis*.
≡ *Culicicola* Niewl. 1916 (*The Amer. Midl. Nat. 4*: 378); espèce type: *Culicicola culicis* A. Braun 1855 (*loc. cit.*) ≡ *Entomophthora culicis*.

Diagnose:

Conidiophores simples, renflés sous l'apex. *Conidies primaires* campanulées, à symétrie axiale, apex pointu ou portant une pointe émoussée; papille basale large très courte tronquée, plate à faiblement convexe, sans épaulement; paroi unituniquée lisse; 2 à 20 noyaux; éjection par projection violente à 1-2 cm, la conidie étant, chez certaines espèces, éjectée avec le contenu cytoplasmique du conidiophore. *Conidies secondaires* d'un seul type, semblables aux primaires ou à apex arrondi. *Spores durables*, azygospores, sphériques, à épispore hyaline à brune, lisse ou avec quelques cannelures. *Cystides* absentes. *Rhizoïdes* absents ou présents.

Espèces pathogènes d'insectes. Quelques espèces cultivées, à croissance lente.

Principales espèces du genre:

E. culicis (A. Braun) Fres.
E. erupta (Dustan) Hall
E. muscae (Cohn) Fres.
E. planchoniana Cornu
E. thripidum Samson et al.
E. weberi Lakon ex Samson in Samson et al.

Genre ERYNIA Nowakowski 1881 (*Dzienn. III Zjazdu Lek. i Przyr. Pol. w. Kraków 6*: 67).
Espèces originales: *Erynia ovispora* Nowak., *E. curvispora* Nowak. et *E. conica* (*nomen nudum* en 1881).

Espèce lectotype: *Entomophthora ovispora* Nowak. 1877 (*Bot. Zeitg. 14*: 220) ≡ *Erynia ovispora*.
  ≡ *Zoophthora* subg. *Erynia* (Nowak. 1881) Batko 1966 (*Acta Mycol. 2*: 18); espèce type: *Entomophthora ovispora* Nowak. 1877 (*loc. cit.*) ≡ *Erynia ovispora*.
= *Zoophthora* subg. *Furia* Batko 1966 (*loc. cit.* p. 20); espèce type du sous-genre: *Empusa virescens* Thaxter 1888 (*Mem. Boston Soc. nat. Hist. 4*: 178) ≡ *Erynia virescens*.
= *Strongwellsea* Batko & Weiser 1965, syn. nov. (*J. Invertebrate Pathol. 7*: 460-463, fig. 1-4); espèce type: *Strongwellsea castrans* Batko & Weiser 1965 (*loc. cit.*) ≡ *Erynia castrans*.

Diagnose:

Conidiophores généralement ramifiés, non renflés. *Conidies primaires* ovoïdes à longuement fusiformes, courbées ou non, généralement à symétrie bilatérale, apex arrondi ou pointu; papille basale arrondie à presque aplatie, parfois indistincte, jamais apiculée, non séparée du corps de la conidie par un épaulement; paroi bituniquée, lisse, adhésive; généralement uninucléées; éjectées par projection à faible distance, 1 cm. *Conidies secondaires* pouvant correspondre à 3 types (a) semblables aux primaires ou un peu plus larges (b) subsphériques avec papille arrondie, à symétrie axiale, parfois indistinctement apiculées au sommet (c) subcylindriques à apex arrondi ou conique, à papille basale indistincte à symétrie axiale, formées sur un conidiophore court et large; conidies des types (a) et (b) éjectées comme les primaires, celles du type (c) probablement détachables passivement; souvent 2 types de conidies secondaires par espèce; capilloconidies toujours absentes. *Spores durables* variables, zygospores formées par anisogamie, azygospores ou inconnues; sphériques, hyalines, jaunes ou brunes, lisses, ridées ou échinulées ou à excroissances bulliformes, parfois formées à l'extérieur de l'hôte. Cystides et rhizoïdes presque toujours présents.

Espèces pathogènes d'insectes, occasionnellement d'arachnides. Culture possible pour beaucoup d'espèces, vitesse de croissance très variable.

Quelques espèces du genre:

Erynia castrans (Batko & Weiser 1965) comb. nov. (*loc. cit.*).
Erynia magna (Humber 1976) comb. nov. ≡ *Strongwellsea magna* Humber 1976 (*Mycologia 68*: 1057-1058, fig. 1-9).
Erynia ovispora (Nowak. 1877) Nowak. 1881.
Erynia virescens (Thaxter 1888) Remaudière & Hennebert 1980.

23 autres espèces sont citées dans ce genre par Remaudière & Hennebert (1980).

Genre ZOOPHTHORA Batko 1964 (*Bull. Acad. Polon. Sci. cl II, Ser. Sci. Biol. 12*: 323-324).
Espèce type: *Empusa radicans* Bref. 1870 (*Bot. Zeitg. 28*: 161-166, 177-186) ≡ *Zoophthora radicans* (= "*Empusa sphaerosperma* Fres." sensu Thaxter 1888).
  ≡ *Zoophthora* subg. *Zoophthora* Batko 1966 (*Acta Mycol. 2*: 16-18); espèce type: *Empusa radicans* Bref. 1870 (*loc. cit.*) ≡ *Zoophthora radicans*.
= *Zoophthora* subg. *Pandora* Batko 1966 (*loc. cit.* p. 18-19); espèce type: *Entomophthora aphidis* Hoffm. in Fres. 1858

(*Abhandl. Senckenb. Naturf. Ges. Frankfurt a.M.* 2: 208-209, fig. 59-67) ≡ *Zoophthora aphidis*.

Diagnose:

Conidiophores ramifiés non renflés. *Conidies primaires* cylindriques, cylindro-coniques à fusiformes, à symétrie axiale, apex arrondi ou conique émoussé; papille basale conique, avec pointe ou apicule, ou arrondie, séparée du corps de la conidie par un petit épaulement; paroi bituniquée, lisse adhésive; uninucléées; éjectées par projection à faible distance, moins de 1 cm. *Conidies secondaires* de deux types, (a) semblables aux primaires ou un peu élargie au centre ou à l'apex leur donnant un aspect faiblement pyriforme, (b) capilloconidies amygdaliformes à falciformes, à symétrie bilatérale, parfois arquées à l'apex qui est émoussé ou pointu mais toujours dépourvu de dispositif adhésif, paroi très peu épaissie, hyaline, lisse, détachables passivement. *Spores durables* azygospores? sphériques, hyalines à brunes, lisses ou à reliefs; non observées chez une espèce. *Cystides* rarement présentes. *Rhizoïdes* presque toujours présents et en général multihyphaux.

Espèces pathogènes d'insectes. Culture souvent possible, croissance lente, parfois rapide.

Quelques espèces du genre:

Zoophthora aphidis (Hoffm. in Fres.) Batko
Z. radicans (Bref.) Batko

6 autres espèces sont citées par Remaudière & Hennebert (1980).

Genre MASSOSPORA Peck 1879 (*31st Ann. Rept. N.Y.St. Mus. Nat. Hist.*: 44).
Espèce type: *Massospora cicadina* Peck 1879 (*loc. cit.*).

Diagnose:

Conidiophores probablement simples. *Conidies primaires* ovoïdes à naviculaires à apex arrondi ou aigu, à courte papille arrondie ou dépourvue de papille et tronquée à la base; à paroi épaisse (peut-être bituniquée) lisse ou verruqueuse, crénelée; 1 à 6 noyaux, le plus souvent 2 en position bipolaire; non éjectées, produites à l'intérieur de l'abdomen de l'hôte, souvent crèmes à brunâtres en masse, libérées par la désintégration de la cuticule de l'hôte. *Conidies secondaires* mal connues ou absentes. *Spores durables*, peut-être azygospores, sphériques à reliefs élevés formant un réticulum diversement ornementé et délimitant des pores profonds, généralement brunâtres en masse. *Cystides* et *rhizoïdes* absents.

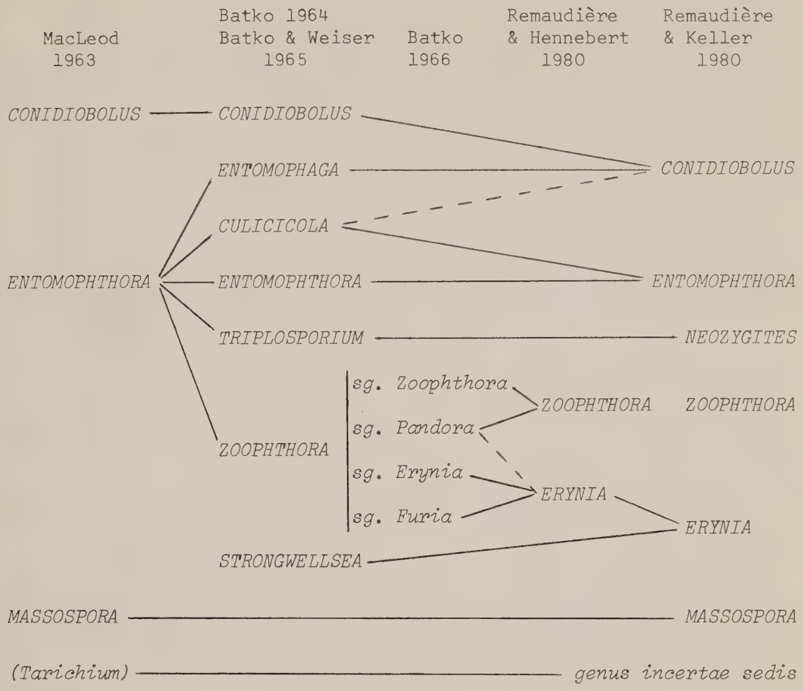
Pathogène hautement spécifique sur *Hom. Cicadidae*. Jamais cultivé.

Onze espèces du genre sont citées et décrites par Soper (1974).

6. CONCLUSION

Parmi les six genres d'Entomophthoracées à potentialité entomopathogène que nous avons retenus, quatre correspondent à des groupes d'espèces très homogènes: *Entomophthora*, *Neozygites*, *Zoophthora* et *Massospora*. Il n'en est pas de même pour les genres *Conidiobolus* et *Erynia*, toutefois les

EQUIVALENCE TAXONOMIQUE DES CLASSIFICATIONS


MacLeod 1963
Batko 1964 Batko & Weiser 1965
Batko 1966
Remaudière & Hennebert 1980
Remaudière & Keller 1980
CONIDIOBOLUS
CONIDIOBOLUS
ENTOMOPHAGA
CONIDIOBOLUS
CULICICOLA
ENTOMOPHTHORA
ENTOMOPHTHORA
ENTOMOPHTHORA
TRIPLOSPORIUM
NEOZYGITES
sg. Zoophthora
ZOOPHTHORA
ZOOPHTHORA
sg. Pandora
ZOOPHTHORA
sg. Erynia
ERYNIA
sg. Furia
ERYNIA
STRONGWELLSEA
MASSOSPORA
MASSOSPORA
(Tarichium)
genus incertae sedis

connaissances acquises à ce jour sur la morphologie et la cytologie des nombreuses espèces classées dans ces genres sont insuffisantes pour permettre un affinement de la classification.

Le tableau ci-dessus permet de comparer notre conception de la classification des genres d'*Entomophthoraceae* à celle des auteurs antérieurs.

Les genres à potentialité entomopathogène que nous avons retenus peuvent être séparés par la clé suivante:

1- Conidies souvent à paroi verruqueuse, jamais éjectées . . . . *Massospora*
- Conidies primaires à paroi lisse, toujours éjectées 2

2- Conidies primaires campanulées, avec pointe apicale . . . . *Entomophthora*
- Conidies primaires jamais campanulées 3

3- Conidies primaires subsphériques à pyriformes, unituniquées, conidiophores simples. 4

- Conidies primaires allongées, ovoïdes à cylindriques ou fusiformes, bituniquées, conidiophores plus ou moins ramifiés. 5

4- Conidies primaires à papille tronquée, capilloconidies à symétrie bilatérale avec à l'apex un disque ou une gouttelette adhésive. . . . . *Neozygites*
- Conidies primaires à papille conique ou arrondie, capilloconidies absentes ou à symétrie axiale et apex non adhésif . . . . *Conidiobolus*

5- Capilloconidies présentes, à symétrie bilatérale, amygdaliformes à falciformes; conidies primaires subcylindriques à fusiformes, avec un épaulement au niveau de la papille . . . . *Zoophthora*
- Capilloconidies absentes, conidies primaires ovoïdes à fusiformes, sans épaulement. . . . . *Erynia*

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THE GENERIC CONCEPT IN HYPHOMYCETES - A REAPPRAISAL

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ABSTRACT

It is postulated that there are now too many genera of Hyphomycetes. The characters used to define them are often inadequate, poorly defined or purely monothetic, and the construction of workable keys has become impossible. The condensation of many groups of genera is suggested, and several possible strategies proposed. Several genera centered on *Beltrania* are analyzed in detail; four other groups of genera are also discussed. Finally, the dangers of ignoring convergent evolution are stressed.

INTRODUCTION

As one of the prime movers in the production of two illustrated compendia of hyphomycete anamorph-genera (Kendrick & Carmichael 1973, Carmichael et al. 1980) I have noted with some despondency the enormously variable amount of confidence we can place in the different descriptions and illustrations scattered through the literature. What a motley assemblage the genera of hyphomycetes are. How could they be anything else, conceived as they have been over a span of two centuries, and in the minds of hundreds of different authors? But the task of compilation was such that we had to focus all our energies on the main objective, rein in our critical faculties (to some extent), and postpone the issue of revision and rationalization.*

Yet these compilations surely allow us, for the first time, to survey our generic patrimony as a whole. I hope that from this ability will spring a dialogue among mycologists about the anamorph-generic concept, and the usefulness of existing genera. This paper is intended as a contribution to such a dialogue.

We deplore the lack of a fossil or genetic base for our classification, and generally agree that anamorph-taxa are mainly matters of convenience. It is my thesis that the number of anamorph-genera of hyphomycetes has already risen to a point where it is no longer convenient. Not only that, but new genera are being proposed in increasing numbers. In 1973 Kendrick & Carmichael recognised about 600 'good' genera. This number has now risen to nearly 900 (Carmichael et al. 1980). It seems inevitable that we will be confronted by well over one thousand such genera long before the end of the century.

Why does this matter? It matters because, having decided that an unknown fungus belongs to the anamorph-class hyphomycetes, the seeker-after-identification (the consumer) must immediately choose among this excessively large, and growing, number, and may encounter two serious, and worsening, difficulties. The first involves the characters used in delimiting genera. As the number of genera grows, the taxonomic gaps which should help to define them are being filled in, or are at least narrowing, sometimes to the point of imperceptibility. New genera are being erected on smaller and smaller bases, and existing genera are being carved up by the recognition of segregate genera. Sometimes these activities are justified by

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* I use this word in the sense of making rational rather than in its frequent interpretation as explaining away irrationality.

differences which, though small, are fundamental (e.g. dolipore septa vs. simple septa - an example of this is cited later in this paper). And, of course, as any experienced taxonomist knows, distinctive segments of the anamorph spectrum remain to be described. But fairly frequently the description of new genera is merely an exercise in splitting hairs. Such exercises serve only to confuse and frustrate the consumer. Here is a powerful reason for a selective but significant reduction in the rate of description of new genera and in the number of genera currently accepted.

The second difficulty involves the mechanics of the system of information storage and retrieval which the consumer must use when trying to identify an unknown. None of the traditional systems can cope properly with 900 genera. Anyone who has picked their way through an extended dichotomous key to hyphomycetes knows that the chance of error increases with each choice made. After encountering a hundred or so couplets, the seeker will usually come up with a name, but may well feel that they have compromised and guessed their way into error. Synoptic keys (Korf 1972, Michaelides et al. 1979) sidestep the endless choosing and allow entry at any point, but are unsuited for use with large numbers of taxa.

If the hyphomycetes could be reasonably classified in a hierarchical manner by means of acceptable orders and families, the monolithic dichotomous key, such as that in Ellis (1971), could be replaced by a number of shorter, more manageable keys: one to the orders; then perhaps one to the families within each order, then one to the genera within each family.

Unfortunately, and probably for the reasons given in detail by Kendrick (1980), hyphomycete taxonomists have largely rejected families and orders for their organisms. Those suprageneric categories erected by Saccardo have fallen into disuse, and those proposed by several more recent authors simply have not caught on, because they ultimately lack credibility. What I wrote about hyphomycetologists in 1971 still holds true: "I often liken a hyphomycete specialist to someone holding a large bunch of balloons (the better the specialist, the larger the bunch of balloons!) Each balloon is a hyphomycete [genus] and each has a separate, independent string leading to it". The balloons are in danger of becoming unmanageable.

Since we cannot bring ourselves to adopt suprageneric categories, it seems to me that a reasonable alternative would be to attempt some condensation of genera, and shift some of the load from the 'generic key' to the 'species keys' that can easily be constructed for even fairly large genera.

One of the aims of this paper will be to show, by means of selected examples, that such a shift could be implemented.

PROPOSED PHASES IN CONDENSATION OF GENERA

I envisage several phases of the condensation process.

1. The first, with which this paper is chiefly concerned, involves the fusion of groups of very similar and, in all probability, truly related genera. The genera in many of these related groups are in fact readily separable in a monothetic way - often by single but well marked characters. Nevertheless, their relatedness enables us to adopt a polythetic generic concept, so that a single larger genus can embrace several extant but narrow genera.

2. A second phase could involve groups of genera in which the very morphological simplicity of the organisms makes one wonder about the convenience and validity of the existing generic delimitations. One such group produces rounded, dark, amerosporous chlamydospores - *Humicola* Traaen, *Gilmaniella* Barron, *Thermomyces* Tsiklinskaya, *Acremoniula* Ciferri, *Desertella* Mouchacca, *Botryoderma* Papendorf & Upadhyay -- and if we extend consideration to dark amerosporous chlamydospores of other shapes, the genera *Rhinocladium* Saccardo & Marchal, *Mammaria* Cesati and *Echinobotryum* Corda can be added.

3. A third phase could involve genera which are morphologically very similar but have different modes of conidiation. Although the fashion in recent years has been to separate such anamorphic fungi, there may be good reasons for reconsidering this position.

For many years von Arx among others has maintained that if the differences between two 'genera' were too inconspicuous to be readily recognised then those genera should not, for all practical purposes, be maintained as separate. His position was well stated by Hennebert (in Kendrick 1971: 115). "Dr. von Arx does not make any distinction between phialides and annellophores. His keys to genera of Hyphomycetes are based on the assumption that for all practical purposes there are no distinguishing characters. He will assert that, since the conidiogenous cell of *Cryptosporiopsis* looks like a phialide in ordinary light microscopy, and has long been called a phialide, he will maintain that usage. Remember also that we may in future decide that poroconidia are really only blastoconidia, and that many phialides are really annellides when we look at their internal arrangements. So von Arx may have some reason to ignore the fine differences between phialides and annellides. We must be careful in making keys. They are only tools, not classifications. They must be practical. Not everyone can look at fungi with an electron microscope to identify them."

For years, caught up as many of us were in the search for features of conidium development, we rejected von Arx's thesis, and called upon each other to push the light microscope to the limits of resolution, and even bring the electron microscope to bear, in order to distinguish between such annellidic, phialidic and sympodial 'genera' as *Leptographium* Lagerberg & Melin, *Phialocephala* Kendrick and *Verticicladiella* Hughes. But now we have come to realise that ontogeny is often much less conservative, and much more plastic, than we had hoped (Madelin 1979, Kendrick 1978) and it is being relegated to the status of just another character, rather than the character. It also appears that the differences between phialides and annellides are more in their externals than in their inner workings.

In his recent revision of *Cladobotryum* Nees ex Steudel, de Hoog (1978) states that "Although markedly different types of conidiation are present in this group of fungi, these characters alone are not sufficient for the delimitation of the genera. They are used here only in combination with other criteria". And indeed, evidence from anamorph-teleomorph connections often runs counter to that from conidium ontogeny. (See Kendrick & DiCosmo 1979, Madelin 1979). So it seems reasonable, when both morphology and relationship point in the same direction, to reconsider some of the ontogenetically based generic segregations made in recent years. Since *Leptographium*, *Verticicladiella* and *Phialocephala* have very similar, complex conidio - phores, and in some cases are associated with teleomorphs in *Ceratocystis* Ellis & Halst., it might be reasonable, as well as convenient, to group them within a single anamorph-genus.

4. A fourth phase might concern itself with recognizing morphological and developmental similarities between some mononematous, synnematous, and possibly even sporodochial and acervular genera, e.g. *Leptographium-Graphium* Corda, *Verticicladiella-Pesotum* Crane & Schoknecht, *Gamsia* Morelet - *Gymnodochium* Massee & Salmon. This phase could explore our growing conviction (Kendrick & Nag Raj 1979) that the gap apparently separating hyphomycetes and coelomycetes is largely illusory. Certainly there seem to be series in which the sporodochial conidioma passes by imperceptible gradations into the acervular conidioma. Genera now placed on opposite sides of this dichotomy might eventually be united. Dr Nag Raj (pers. comm.) is currently exploring this possibility.

In our long search for a more natural basis on which to classify fungi, we must use our growing knowledge of anamorph-teleomorph connections to detect similarities that may underlie and supersede the old categories 'mononematous-synnematous-sporodochial-acervular.' Eventually we may perceive in the ascomycetes and basidiomycetes as a whole a beautifully regular pattern like that found among the anamorphs of the rust fungi, and we must keep such possibilities in mind. This fourth phase might well serve more than one purpose: a glance at the synnematal 'genera' compiled by Carmichael et al. (1980) shows that a lot of them seem virtually indistinguishable, e.g. *Crinula* Fries - *Dendrostilbella* Höhnel - *Phialographium* Upadhyay & Kendrick. This is a sure sign that many such genera need to be critically re-examined. Taxonomists please note.

5. A fifth phase could bring about the final and long overdue extirpation of those anamorph-genera obligately based on the co-occurrence of two different anamorphs on the same mycelium, e.g. *Thielaviopsis* Went, *Chalaropsis* Peyronel, *Dimorphospora* Tubaki, *Duosporium* Thind & Rawla, *Diheterospora* Kamyschko, *Dwayabeeja* Subramanian, *Triadelphia* Shearer & Crane, *Mycochlamys* Marchand & Cabral. In most cases generic names already exist for the individual anamorphs of which these composite genera are made up. For example, *Chalaropsis* is an unnecessary name for a *Chalara* (Corda) Rabenhorst and a *Humicola*. *Mycochlamys* comprises a *Humicola* and a *Scytalidium* Pesante.

Other phases may emerge during the debate, but it is time to return to the main theme of this paper - what I have called phase one.

PROPOSED AMALGAMATION OF CONTIGUOUS GENERA

Perusing the 129 plates in Carmichael et al. (1980) and the fine illustrations in Ellis (1971, 1976) one is occasionally struck by groups of 'genera' whose members exhibit what might be called a 'family likeness'. These are the first candidates for a more detailed scrutiny. The following 26 groupings will exemplify the idea.

(*Chalara* - *Chaetochalara* Sutton & Pirozynski)
(*Catenularia* Grove ex Saccardo - *Chloridium* Link - *Dischloridium* Sutton - *Bisporomyces* van Beyma)
(*Clonostachys* Corda - *Mariannaea* Arnaud)
(*Selenosporella* Arnaud ex McGarvie - *Umbellidion* Sutton & Hodges)
(*Beltrania* Penzig - *Beltraniopsis* Batista & Bezerra *Ellisiopsis* Batista - *Beltraniella* Subramanian - *Pseudobeltrania* P. Hennings)
(*Rhinocladiella* Nannfeldt - *Ramichloridium* Stahel ex de Hoog)

(*Phymatotrichopsis* Hennebert - *Amphobotrys* Hennebert - *Dichobotrys* Hennebert - *Glischroderma* Fuckel - *Pulchromyces* Hennebert - *Chromelosporium* Corda - *Streptobotrys* Hennebert - *Verrucobotrys* Hennebert - *Botrytis* Persoon ex Fries)
(*Haplobasidion* Eriksson - *Echinocatena* Campbell & Sutton - *Lacellinopsis* Subramanian)
(*Fulvia* Ciferri - *Alysidiopsis* Sutton - *Cladosporium* Link ex Fries - *Sorocybe* Fries)
(*Ovulariopsis* Patouillard & Hariot - *Oidium* Saccardo)
(*Staheliella* van Emden - *Botryomonilia* Goos & Pirozynski - *Oidiodendron* Robak)
(*Antromycopsis* Patouillard & Trabut - *Sclerostilbum* Povah)
(*Arthrinium* Kunze ex Fries - *Cordella* Spegazzini- *Pteroconium* Saccardo ex Grove)
(*Mycosylva* Tulloch - *Pachnodium* Upadhyay & Kendrick)
(*Circinotrichum* Nees ex Persoon - *Gyrothrix* (Corda) Corda - *Ceratocladium* Patouillard)
(*Hyphodiscosia* Lodha & Chandra Reddy - *Leptodiscella* Papendorf)
(*Cylindrotrichum* Bonorden - *Chaetopsis* Greville)
(*Cyphellophora* de Vries - *Phialogeniculata* Matsushima - *Phialophora* Medlar)
(*Myrothecium* Tode ex Fries - *Septomyrothecium* Matsushima)
(*Torula* Persoon ex Fries - *Dwayabeeja* Subramanian - *Bahusaganda* Subramanian)
(*Septonema* Corda - *Lylea* Morgan-Jones)
(*Varicosporium* Kegel - *Dendrospora* Ingold - *Dendrosporomyces* Nawawi, Webster & Davey)
(*Scorpiosporium* Iqbal - *Tricladium* Ingold)
(*Heliscus* Saccardo - *Clavatospora* Nilsson)

Such groups have both morphological and developmental similarities, and many are also cemented by our knowledge of the respective teleomorphs. It would obviously take far too long to discuss all of them, so I have selected five examples for further consideration. The first of these may be regarded as a test case and has been set forth in considerable detail.

1) *Beltrania-Beltraniopsis-Ellisiopsis-Beltraniella-Pseudobeltrania*

The anamorph-genus *Beltrania* Penzig 1882 was erected for the single species *B.rhombica* Penzig. *B.querna* Harkness was added two years later. In 1886 Penzig and Saccardo thought the conidia were didymosporous, and although Penzig's type specimen has been lost, a clearly recognizable concept had been established, and by 1963, when Pirozynski's beautifully illustrated account of the tribe appeared, it had grown to six anamorph-genera with 11 species in all. This despite Pirozynski's recognition of a very broad 'neoconcept' for *B.rhombica*, and his synonymization of *B.indica* Subramanian and *B.multispora* Swart with it.

In the intervening seventeen years the number of species in the tribe has doubled, reflecting the sharply increased concern of mycologists with conidial fungi. Perhaps surprisingly, the number of 'genera' involved has remained constant. My question is whether that number should in fact be reduced. The quotation which follows is from Kendrick & Carmichael (1973) " ... the recently recognized form-genera *Beltraniella*, *Ellisiopsis* and *Beltraniopsis* are differentiated from the classical *Beltrania* by characters which could easily be regarded as valid only at the species level ... [the species of these genera] are so similar that they should probably be treated as congeneric in any practical, working classification". These genera are indeed separable by single characters, but they probably represent a luxury we can no longer afford, if our system is to be manageable, so this seems an appropriate place to take up and extend the earlier discussion. The species of the genera *Beltrania*, *Beltraniopsis*, *Beltraniella* and *Ellisiopsis*, as well as those of two other genera, *Pseudobeltrania* and *Hemibeltrania* Pirozynski, which are relevant to the discussion, are all illustrated in Ellis (1971:237-235, 1976:200-207).

Let us first analyze the constellation of characters that make *Beltrania* distinctive. Almost unique among hyphomycetes are the striking biconic conidia which are lightly pigmented but have a narrow hyaline band at the conjunction of upper and lower cones. This strangely shaped conidium also has a tubular apical appendage and often a basal 'separating cell', swollen in the middle, but narrowly truncate at each end. The separating cells arise from denticles clustered at the apex of unbranched, multiseptate conidiophores which spring from around the radially lobed, rosette-like bases of long, dark, pointed setae.

There is a strong tendency for anamorph-genera to be monothetic; that is, for them to be based on the possession by all member species of a unique feature or features. Among the *Beltrania*-like hyphomycetes this means that an all-or-nothing reliance on one or two characters has led to the recognition of several numerically small genera. The salient features of these genera are analyzed in Table 1. I have tried to rate these features in terms of their frequency of occurrence over the whole spectrum of hyphomycetes. My categories range from: ' * = unique', through '** = very rare', to '*** = unusual', to '**** = common'. From the point of view of their value as characters delimiting monothetic genera, we can surely discount the four-star features completely. For example, anamorph-genera with '(1) Conidia amerosporous' fill no fewer than 55 of the 129 plates in Carmichael et al. (1980). '(3) Conidia lightly pigmented' and '(4) Conidia limoniform or obovoid' are less common, but can still be found in scores of genera. '(5) Conidiophores arising from substrate' must describe the majority of all hyphomycetes and is only included as a foil for those arising along the setae.

Let us pass on, then, to the remaining characters. Three (#6-8) are rated as "unusual". '(6) Dark setae' can be found in about 30 anamorph-genera (e.g. *Chaetochalara*, *Codinaea* Maire, *Cordella*, *Lacellina* Saccardo, *Lacellinopsis*, *Mahabalella* Sutton & Patil, *Minimidochium* Sutton, *Septosporium* Corda). This total does not include genera with setiform conidiophores. An interesting situation arises with the publication of *Beltrania mundkurii* and *B.santapaui*, whose setae are often branched, since it is on branched vs. unbranched setae that the genera *Gyrothrix* and *Circinotrichum* are differentiated - see below '(7) Conidiophores

Table 1

Salient Features of the *Beltrania* group and other selected genera

	Frequency rating of characters	Beltrania	Beltraniopsis	Beltraniella	Ellisiopsis	Psuedobeltiania	Hemibeltrania	Rhombostilbella	Chaetendophrag-mia	Subulispora
1. Conidia amerosporous	****	√	√	√	√	√	√	√	x	x
2. Conidia phragmosporous	****	x	x	x	x	x	x	x	√	√
3. Conidia lightly pigmented	****	√	√	√	√	√	√	x	√	√
4. Conidia limoniform or obovoid	****	x	x	x	x	x	√	x	x	x
5. Conidiophores arising from substrate	****	√	√	√	√	√	√	√	√	√
6. Dark setae present	***	√	√	√	√	x	x	x	x	x
7. Conidiophores arising along setae	***	x	√	√	√	x	x	x	x	x
8. Conidia beaked or apiculate	***	x	√	x	x	√	(√)	√	√	√
9. Conidia with hyaline equatorial band	**	√	√	√	√	√	x	x	x	x
10. Bases of setae or conidiophores radially lobed	**	√	√	√	√	√	√	x	√	√
11. Conidia biconic	**	√	√	(√)	x	√	x	√	x	x
12. Conidia turbinate	*	x	x	√	√	x	x	x	x	x
13. Conidia with apical, tubular, non-septate appendage	*	√	x	x	x	x	x	x	x	x
14. Swollen separating cell often present	*	√	√	(√)	(√)	x	x	x	x	x

Weighting used in Table 4

**** = 1,   *** = 3,   ** = 7,   * = 10

No character is included in the key unless it is present in at least two of the fungi and therefore contributes to similarity.

(or conidiogenous cells) arising along setae.' This condition is about as frequent as that described above (#6); examples are *Chaetopsina* Rambelli, *Chaetopsis* Greville, *Conoplea* Persoon, *Cryptophiale* Pirozynski, *Gonytrichum* Nees & Nees, *Hansfordia* Hughes, *Kumanasamuha* Rao & Rao, and *Zanclospora* Hughes & Kendrick. '(8) Conidia beaked or apiculate' Depending on just how it is interpreted, this feature occurs in at least 40 anamorph-genera of hyphomycetes (excluding staurosporous and scolecosporous forms). Examples are: *Echinobotryum*, *Hansfordiella* Hughes, *Hansfordiellopsis* Deighton, *Sessiliospora* Hawksworth, *Sporidesmium* Link, *Toxosporium* Vuillemin, *Walkeromyces* Thaung).

It is apparent that the last six features (#9-14) carry the real taxonomic weight. '(9) Conidia with hyaline equatorial band'. Darker central bands are found in a number of genera, and longitudinal germ slits are not uncommon, but a hyaline band around the body of the conidium is rare. I am aware of such a feature only in *Arthrinium*, *Pteroconium* and *Cordella* (three very similar genera) outside the *Beltrania* group, in which five of the six 'genera' share this character. One species of *Beltraniella*, *B.porosa* Pirozynski & Patil, has several equatorial hyaline pores in place of the continuous band. This configuration is unique, and were the fungus not so obviously a member of the *Beltrania* group, could easily have led to its segregation at the generic level.

'(10) Bases of setae or conidiophores radially lobed' The bases of setae and conidiophores in many genera are swollen (e.g. *Cacumisporium* Preuss, *Sporoschismopsis* Holubová-Jechová & Hennebert, *Circinotrichum*, *Periconia* Tode ex Persoon), but I am aware of the existence of radial lobes in only two genera -- *Chaetendophragmia* Matsushima and *Subulispora* Tubaki -- outside the *Beltrania* group. Within the group, species of all six 'genera' possess this feature. Because of its rarity, common possession of this character must raise questions about the possible relationships among the genera concerned. It is difficult to be dogmatic in a group so poorly known genetically and palaeontologically, yet neither *Chaetendophragmia* nor *Subulispora* resembles the

Beltrania group in most ways: a comparison is given in Table 2. This suggests that the lobing may have arisen separately on at least three occasions as a solution to the common problem of obtaining stability for tall structures.

Table 2

A comparison of anamorph-genera with radially lobed conidiophore bases.

	Beltrania group	Subulispora	Chaetendophragmia
conidiophore bases radially lobed	√	√	√
conidia pigmented	√	x	√
conidia with apical appendages	(√)	x	√
conidia with lateral appendages	x	x	√
conidiophore proliferating	x	x	√
conidiophore proliferating sympodially	x	√	x
separating cells present	√	x	x
conidia phragmosporous	x	√	√
conidia arising on denticles	√	x	x

'(11) Conidia biconic. Of the six genera in the *Beltrania* group, four share this feature. Only two other hyphomycete genera produce conidia of this shape: the hyaline, synnematous, fungicolous *Rhombostilbella* Zimmermann, and the hyaline, sporodochial *Fusisporella* anamorph of *Nectria pallidula* Cooke. It seems most probable that the similarity in conidium shape is coincidental, and that neither of these fungi is related to *Beltrania*. As Pirozynski (1963) pointed out, biconic spores are found among the Sphaeriales, Microthyriales and Helotiales, so this shape is not necessarily good evidence for close relationship.

'(12) Conidia turbinate.' This means 'shaped like a child's whipping top.' Such conidia have a rounded or rather flattened apex, and a pointed base. Yet the word turbinate specifies an over-all shape rather than simply those of base and apex. So although it is not hard to find genera whose conidia have a rounded or flattened apex and a tapered base, these usually have little resemblance to *Beltraniella* or *Ellisiopsis*. I think it is fair to suggest that, were the shape of the conidia in these two genera to be fully specified (as in a drawing, rather than as an oversimplified verbal description) it would be essentially unique: the *Exosporiella fungorum* (Fries) Karsten conidium is about the only example I can think of that bears it much resemblance.

'(13) Conidia with one apical, tubular, nonseptate appendage.' Apical appendages are common among coelomycetes, but found in relatively few genera of hyphomycetes, especially if one excludes forms with a simple apical extension like that of some species of *Alternaria* Nees or *Hansfordiella*, and discriminates between the fine non-cellular setulae of such genera as *Codinaea*, *Mahabalella*, *Menispora* Persoon, *Menosporopsis* Hughes, *Minimidochium* and *Mycoleptodiscus* Ostazeski, and the tubular kind that lack cytoplasmic content at maturity. *Camposporium* may have 0-several appendages, sometimes septate; *Chaetendophragmia* has one or two lateral appendages in addition to the apical; *Pleiochaeta* (Saccardo) Hughes usually has two or three apical appendages. If one can exclude the 'beaks' of e.g., *Phaeotrichoconis crotalariae* (Salam & Rao) Subramanian and *Blastodictys hibisci* (Hansford) Ellis (which are very appendage-like, and suggest that the word 'appendage' needs some attention), only *Monotrichum* Gaeumann is seen to possess anything comparable to the appendage found in some species of *Beltrania*.

'(14) Swollen separating cell often present.' Separating cells are found in more than twenty anamorph-genera of hyphomycetes. Sometimes they are nothing more than a denticle which has a septum laid down across the base. The denticle may be very short, as in *Dematophora* Hartig, *Conoplea* or *Hansfordia*, and the separating cell therefore disc-like. In other genera the denticle is larger (*Nakataea* Hara, *Pyricularia* Saccardo, *Parapyricularia* Ellis) and in yet others it may be very long in proportion to its width (*Brachysporium* Saccardo, *Paratrichoconis* Deighton & Pirozynski, *Rhombostilbella*). The separating cells of these genera differ from those of the *Beltrania* group in three significant ways. First, they are all cylindrical or tubular - none is swollen in the manner typical of those in *Beltrania*, *Beltraniopsis*, *Beltraniella** or *Ellisiopsis*. Second, the cylindrical kind of separating cell usually ruptures when the single conidium it bears secedes, part of the cell going with the conidium, part remaining attached to the conidiogenous cell. In the *Beltrania* group, the swollen separating cell does not usually rupture, but either remains on the conidiophore in its entirety or secedes with the conidium. Third, it is fairly common for a separating cell of the *Beltrania* group to bear more than one conidium: I am not aware of such behaviour among cylindrical separating cells. So, although several other genera have separating cells, those of the *Beltrania* group are unique.

Even a cursory examination of the ratings in Table 1 will convince the reader that the *Beltrania* group occupies a fairly well-defined region of the fungal spectrum. If we look only at the six most unusual features, we find that only one, radially lobed setae or conidiophore base, is present in all six pseudotaxa, though another, the hyaline equatorial band, is found on the conidia of five of the six, and two more (biconic conidia and swollen separating cells) are found in four of the six 'genera'.

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* Separating cells of *Beltraniella nilagirica* Pirozynski & Patil may be cylindrical, but they are much wider than the denticles from which they arise, and each commonly bear several conidia, as in other *Beltraniella* species.

Table 3 shows the results of cross-matching the various features present in each 'genus' in an unweighted manner. However, in the normal taxonomic approach some features are always given more 'weight' than others. I thought it would be salutary to visualize this usually cerebral process, and assigned weightings of 10, 7, 3 and 1 to the four degrees of rarity recognized earlier. Although this scheme is doubly arbitrary, it produces similarities (Table 4) that do not seem unrealistic when one makes the usual mental comparisons.

I admit that this comparison is made on a limited sample of data, but I am fairly sure that it was upon just these characters that the original 'generic' delimitations were based.

Table 4 makes it clear that *Hemibeltrania* is peripheral or even external to the *Beltrania* group. Although it shares four or five features with each of the other genera in the group, three of these are of the common or garden variety, and only feature 11, the radially lobed conidiophore base, a seven-point character, gives it any semblance of credibility as a member of the group. To drive this point home further, I have compared *Chaetendophragmia triangularia* Matsushima and *Subulispora procurvata* Tubaki with the 'genera' of the *Beltrania* group, extending Table 1 as necessary to include all the main features, and found that each of them was, in fact, just as 'close' to the other members of the *Beltrania* group as is *Hemibeltrania*. Note that this degree of similarity is essentially based on two features, the '3-point' apiculate conidia and the '7-point' radially lobed conidiophore base.

In the conidial fungi we are, as I have recently pointed out at some length (Kendrick 1980), at a considerable disadvantage when speaking about conservatism in characters because we have so little fossil record on which to base conclusions. Yet if we can attach some importance to 'shared rarity' (and how else can we taxonomize organisms) we could suggest that *Chaetendophragmia triangularia* and *Subulispora procurvata*, no less than species of *Hemibeltrania*, may be related in some way to the otherwise closely knit *Beltrania* group. But although there is, as I have tried to demonstrate, a strong case for condensing the five *Beltrania* genera into one (as their weighted resemblances in Table 4 suggest), there can be little justification for including *Hemibeltrania, Chaetendophragmia* or *Subulispora* in this expanded generic concept.

Table 3

Positive resemblances between genera (unweighted - out of 10)

	Beltraniopsis	Beltraniella	Ellisiopsis	Pseudobeltrania	Hemibletrania	Rhombostilbella
Beltrania	8	8	7	6	4	3
Beltraniopsis		9	8	7	5	4
Beltraniella			9	6	4	3
Ellisiopsis				5	4	3
Pseudobeltrania					5	4
Hemibeltrania						3

Table 4

Positive resemblances between genera.
(Weighted - out of 47).

	Beltraniopsis	Beltraniella	Ellisiopsis	Pseudobeltrania	Hemibeltrania	Rhombostilbella	Chaetendophragmia	Subulispora
Beltrania	37	37	30	24	10	9	9	8
Beltraniopsis		40	33	27	13	12	12	11
Beltraniella			43	27	10	9	9	8
Ellisiopsis				17	10	2	9	9
Pseudobeltrania					13	12	12	11
Hemibeltrania						5	12	11
Rhombostilbella							4	5
Chaetendophragmia								12

The five core 'genera' in what I have called the *Beltrania* group contain in all only about 20 species. I suggest that even were the number of species to double (which it well may, as the hyphomycetes of the tropics are more fully enumerated) it would be easier to track down any of them initially under a single generic heading (largely on the basis of qualitative features) then run it down to species by using the remaining qualitative features for subgeneric groupings (which might correspond to the genera now recognized), and finally by means of quantitative differences.

If we adopt the traditional monothetic stance, we can define the *Beltrania* group as producing biconic, or sometimes turbinate, pigmented conidia which have a hyaline equatorial band. But that gives a very inadequate account of the group as a whole, and since other very unusual or even unique characters are also found in the majority of species within the group, it seems more reasonable to include those in the generic constellation, adopting a more polythetic approach.

Among the unusual, rare, or unique features already enumerated, no less than five are present in at least four of the five genera. These five features (# 6,9, 10,11,14 in Table 1) are present in *Beltrania*, *Beltraniopsis* and *Beltraniella;* four of them in *Ellisiopsis*, and three in *Pseudobeltrania*. Only one of the five is found in *Hemibeltrania*. I propose, then, that membership in the expanded, slightly polythetic genus *Beltrania* sensu lato be granted to fungi possessing any three of the five features listed below: (1) dark setae, (2) setae or conidiophores with radially lobed bases, (3) swollen separating cells, (4) biconic conidia (5) conidia with hyaline equatorial band.

Using this polythetic concept, I believe that all species thus far described in *Beltrania*, *Beltraniopsis*, *Beltraniella*, *Ellisiopsis* and *Pseudobeltrania* fall within the limits of the single expanded anamorph-genus. *Hemibeltrania* is clearly excluded.

It is encouraging to note that Pirozynski & Patil (1970) foreshadowed the present paper by reducing *Ellisiopsis* to synonymy with *Beltraniella*.

I have deliberately delayed until this point any consideration of the species most recently described in *Hemibeltrania, H. navicularis* Sutton. Sutton (1976) reports that his collections of the new taxon "have not only shown characteristics of *Hemibeltrania* but also extraneous features [sic] not hitherto reported in the family [sic]." Sutton notes that the new species is "similar in morphology and ontogeny of conidia ..... to *Hemibeltrania* species but in addition to solitary conidia it produces short chains of up to 3 conidia. Were it not for this feature there would be no hesitation in placing the species in *Hemibeltrania*, but, if a strict interpretation of the generic limits is imposed, there would be no alternative to the introduction of a new generic name to accommodate it."

I consider that the inclusion of this species in *Hemibeltrania* involves an excessive extension of the generic concept. Not only are the conidia of the two extant species of *Hemibeltrania* obovoid or limoniform and not at all 'navicular' or spindle-shaped, but they never form in chains, and completely lack the swollen separating cells which Sutton invokes as a derivative of the chains found in his fungus. If we can extend the generic limits of *Hemibeltrania* to include an additional shape of conidia, and conidia in chains, how much easier it would be to extend the limits of *Beltrania* to incorporate the other four genera already mentioned, which already have so much in common with the original genus. Sutton's new fungus, even if it can be postulated as having some relationship with the *Beltrania* group - and perhaps it can - must surely be regarded as distinct both from *Beltrania* sensu lato and from *Hemibeltrania*. It possesses none of the constellation of five features that characterize *Beltrania* sensu lato, and is not much more similar to *Hemibeltrania*, as that genus has generally been understood. It could, in fact, be considered more closely allied to *Spondylocladiopsis* M.B. Ellis, or to *Haplariopsis* Oudemans (see Ellis 1971: 293-294).

Since this is the beginning of the debate, I am deliberately refraining from making the suggested transfers, not wishing to prejudge the outcome, or to clutter the literature with combinations that may, if the argument goes against them, be rendered superfluous.

(2) *Chalara* - *Chaetochalara*

As Nag Raj & Kendrick (1975) showed, *Chalara* is unique in its production of cylindrical, phialidic, amerosporous or didymosporous conidia from a conidiogenous locus lying at the base of an extended cylindrical collarette. Unique, that is, except for the contiguous genus *Chaetochalara*, which has exactly the same characteristics, with one addition, that of dark setae. Although Nag Raj & Kendrick were conservative and retained both genera, it seems to me that there is now very little reason to do so. *Chaetochalara* has only six species (Nag Raj & Kendrick 1975) and could be absorbed into *Chalara* with virtually no loss of information, since the six species would constitute a small subgeneric group that could be quickly keyed out on their possession of setae ... (Remember that some members of *Beltrania* sensu lato have setae, while some do not). I propose, therefore, that the concept of the genus *Chalara* be expanded to admit species with setae, *Chaetochalara* becoming a facultative synonym of *Chalara*

(3) *Circinotrichum* - *Gyrothrix* - *Ceratocladium*

The only feature separating *Circinotrichum*, with six species, from *Gyrothrix*, with twelve, is the unbranched setae of the former vs. the branched setae of the latter (See Pirozynski 1962). Species of these two genera are remarkably similar in every other respect. Referring back to the *Beltrania* discussion, we may note that two species of *Beltrania*, *B. mundkurii* Pirozynski & Patil and *B. santapaui* Pirozynski & Patil have recently been described as having branched setae, while the other members of *Beltrania* sensu stricto all have unbranched setae. Although I know it is not always safe to transfer taxonomic conclusions from one situation to another, this is surely a case in which what makes sense in *Beltrania* does so also in *Circinotrichum* - *Gyrothrix*. I therefore suggest unification of the two genera, with *Gyrothrix* becoming a facultative synonym of *Circinotrichum*.

Ceratocladium Corda 1839, with one species, *C. microspermum* Corda, has branched setae like *Gyrothrix*, but while the conidiogenous cells in *Gyrothrix* arise from the substrate, the almost identical cells of

Ceratocladium arise along the lower part of the setae. This might seem like a reasonable generic distrinction, but for the fact that the conidiogenous cells of a recently described *Circinotrichum, C. pseudocladum* Pirozynski & Patil, also develop along the lower portion of the setae. Thus *Ceratocladium microspermum* is to *Gyrothrix* what *Circinotrichum pseudocladum* is to the rest of *Circinotrichum*. If *C. pseudocladum* can be accepted as a good species of *Circinotrichum* (and I do not see why it should not be), then *Ceratocladium microspermum* can now be logically and comfortably disposed in *Gyrothrix* - and hence in *Circinotrichum* sensu lato. Once again it is encouraging to note that Pirozynski & Patil (1970) having described *Circinotrichum pseudocladum,* drew attention to the same logical redisposition of *Ceratocladium microspermum,* though they did not go as far as to propose the second step.

(4) *Antromycopsis - Sclerostilbum*

Sclerostilbum septentrionale Povah has recently been revealed as the synnematal anamorph of *Collybia racemosa* (Persoon ex Fries) Quelet (Watling & Kendrick 1977). Its conidia are formed by the arthric disarticulation of closely clamped hyphae in the head of the synnematal conidioma. Quite independently, it has also been shown that *Antromycopsis broussonetiae* Patouillard & Trabut is the synnematal anamorph of *Pleurotus cystidiosus* O.K. Miller (Jong & Peng 1975, Pollack & Miller 1976). Its conidia form in exactly the same manner as those of *Sclerostilbum,* though the *Pleurotus* also produces an anamorph on the monokaryotic mycelium: this is, of course, not clamped and the arthric conidia are not as distinctive as those of the dikaryon.
The literatures of these two basidiomycetous anamorphs have followed separate, if parallel, paths, and the actual comparison between them has been made only very recently (Watling & Kendrick 1977, Kendrick & Watling 1979). It seems that there is little reason to maintain them as separate anamorph-genera, and I propose that *Sclerostilbum* should become a facultative synonym of *Antromycopsis*.

(5) *Heliscus - Clavatospora*

Heliscus lugdunensis Saccardo & Therry, the type species of *Heliscus* Saccardo, has tetraradiate, amerosporous, phialidic conidia in which the three upwardly directed arms are comparatively short (Carmichael et al. 1980, Fig. 117D). Because those of *H. longibrachiatus* Ingold were much longer, Nilsson established the segregate genus *Clavatospora* Nilsson ex Marvanova & Nilsson for it. The only significant difference between *H. lugdunensis* and *C. longibrachiata* (Ingold) Nilsson (Carmichael et al. 1980, Fig. 119A) lies in the respective lengths of the three upper arms of their conidia. Since both species are amphibious, and the conidia of both are basically amero-staurosporous and phialidic, I consider their segregation to have been unnecessary. I therefore suggest that *Clavatospora* should become a facultative synonym of *Heliscus*.

EXCEPTIONS DUE TO CONVERGENCE

I must now sound a note of warning. The staurosporous conidia of *Varicosporium*, *Dendrospora* and *Dendrosporomyces* share a basic pattern of construction even to the constrictions at the base of each branch or arm of the conidium. Yet Nawawi et al. (1977) showed unequivocally that *Dendrosporomyces prolifer* Nawawi, Webster & Davey has dolipore septa, and must therefore be a basidiomycetous anamorph. *Dendrospora erecta* Ingold, on the other hand, has simple septal pores, and is therefore assumed to be an ascomycetous anamorph. The status of *Varicosporium* has not yet been resolved.

Spiniger Stalpers was erected for basidiomycetous anamorphs that in most ways resemble *Oedocephalum* Preuss. We may expect to encounter other unclamped basidiomycetous anamorphs which may well display similar parallelism or convergence with ascomycetous anamorphs. But these cases will be the exception rather than the rule. I do not think that arguments of possible polyphyly can reasonably be advanced to defend many of the segregate genera produced in recent years.

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SOME TAXONOMICAL CONSIDERATIONS ON *CANDIDA* AND ALLIED GENERA

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SUMMARY

The authors discuss the taxonomy of *Candida, Torulopsis* and *Cryptococcus*. According to a previous proposal the Aa. still retein valid the idea of unify these genera. However it seems necessary that two genera are created from the resulting larg grouping: this to separate the species related to hemiascomycetes from those related to basidiomycetes.

During a meeting on the genus *Candida,* held in Pisa in December 1977, the systematic status of the genus was discussed (1). The idea of joining together *Candida* and *Torulopsis,* so far regarded as being separate genera, was considered worthy of attention. The validity of this proposal was warranted by several arguments, the most convincing of which was the recognition of the fact that the main differentiating character, i.e. the ability to form mycelial filaments, is valueless.

We ourselves mentioned some species which originally known to be filamentous, subsequently lost this property. On the other hand there are some tipically not filamentous species that under the influence of particular stimuli, show filament production. Moreover, structural, biochemical and taxonomic similarities between *Candida* and *Torulopsis* were mentioned.

In this comunication we intend to confirm our previous statements and to add some additional considerations.

Our discourse starts from the genus *Cryptococcus*. As it has been pointed out by Phaff and Spencer (2), it is more and more difficult to maintain the distinctions among *Cryptococcus, Torulopsis* and *Rhodotorula*. Capsule formation, absence of myceliar filaments and inability to produce carotenoids have lost much of their validity as discriminating characters. Perhaps the ability to assimilate inositol is the only discriminating character. Not much indead! Moreover the validity of this character is questionable, because some species included in the genus *Candida* are able to utilize inositol.

Moreover, till a short while ago it was assumed that none of the *Cryptococcus* species produces spores. The diagnosis of the genus prepared by Phaff and Spencer says: "ascospores, teliospores, ballistospores are not produced". Now the situation has changed. It has been shown that also the type species *Cryptococcus neoformans* has a sporogenous stage, characterised by filament formation and by the production of heterobasidious like structures, for this phase the genus *Filobasidiella* Kwon-Chung was established. Subsequently, two additional species have been found to be sporogenous: *Cr. cereanus* Phaff et al. and *C. lactativorus* Fell et Phaff. But these species are related at one ascogenous genus: *Sporopachidermia* Rodrigues de Miranda. Hence in the *Cryptococcus* the situation of *Torulopsis* and *Candida* exists.

As far as *Torulopsis* and *Candida* are concerned, van Uden and Buckley (3) have really pointed out that the separation of the two genera was based upon arbitrary standards.

In 1977 we proposed the unification of *Candida* and *Torulopsis* on the basis of several arguments (1).

In october 1978 Yarrow and Meyer (4) advanced the same proposal, suggesting simply the suppression of the genus *Torulopsis* through the transfer of its species into *Candida*. To do this, they introduce the following amendment in the *Candida* diagnosis: "pseudoyphae absent, rudimentary or well developed".

The Yarrow and Meyer amendment leaves the problem of the characterization of the genus unsolved since characterization of the genus unsolved since filamentation, withe the other characters, is no longer valed. The only attribute remaining in this large group of asporogenous yeasts is cell-shape, although variable. In one sense it is a return to the past.

We believe that the right approach to the taxonomic revision of the yeast including *Candida, Torulopsis* and, eventually, *Cryptococcus*, must start from the basic consideration, already advanced by us in 1977, that within each genus there are taxa belonging to hemiascomycetes and taxa belonging to the heterobasidiomycetes.

It is evident that yeast species showing such a great taxonomic diversity cannot be grouped under the same genus. It is well known that the different taxonomic position entails peculiar properties: i.e. the value of G + C%, the structure of the cell wall, the structure of hyphal septa when hyphae or pseudohyphae are produced, etc.

It must be stressed that within Deuteromycetes (Hyphomycetes) this distinction is usually made. For example, *Spiniger* Stalpers has been segregated from *Oedocephalum* because its sexual stage shows basidiomicetous characters (5). Idem for *Moniliophthora* Evans et al. segregated from *Monilia* for identical reasons (6).

We suggest that the *Candida-Torulopsis-Cryptococcus* group might well be divided into two genera on the basis of their phylogeny.

The introduction in the diagnosis of the sentence "DBB positive" for one genus and "DBB negative" for the other is sufficient:(·)

> "Cells globose, oval, elliptical or elongate; never apiculate, trigone or flash-shaped. A rudimentary or a more or less developed pseudomycelium may be present. Some species produce a capsule. Multiplication by budding.
> Nitrate assimilation: variable.
> Fermentation: positive or negative
> DBB: positive
> For some species a sexual stage referable to the heterobasidiomycetes is known".
> "Cells globose etc......
> DBB: negative
> For some species a sexual stage referable to the hemiascomycetes is known".

The biochemical characters maintain their taxonomic importance in the definition of the single species and variety.

The denomination of the two genera is irrelevant question.

Finally, since the new taxonomic attachment will lead to an increased amount of species, it would be desirable to arrange them into groups, by analogy with the situation of other large genera (i.e. *Aspergillus*, *Penicillium*, *Fusa-*

(·) For DBB test see van der Walt and Hopsu-Havu (7).

rium, etc.).

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TRICHOPHAEA CONTRADICTA: A NEW COMBINATION AND AN EMENDED DESCRIPTION FOR PATELLA CONTRADICTA SEAVER[1]

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SUMMARY

A culture derived from a British Columbia collection of "*Patella*" *contradicta* produced both the teleomorphic state and a *Dichobotrys* anamorphic state when grown on several media. The teleomorphic state characteristics are intermediate between those of *Trichophaea* *s. str*. and *Sphaerosporella*. The anamorphic state has 8-9 µm diameter subglobose to globose conidia with a 1 µm broad pedicel and typically produces three to five conidia per conidiogenous cell. The isolate has a rosy buff to salmon pink colonial and conidial color when grown on PDA under 12 hr diurnal fluorescent illumination, and mature apothecia are present 18-21 days after inoculation onto CM or CMMY agar. The combination *Trichophaea contradicta* (Seaver) comb. nov. is proposed and an emended description is given.

A small, lenticular, dark brown discomycete was collected in British Columbia during June 1971. Its distinctive features were: the smooth, broadly ellipsoidal ascospores; the short, light-colored marginal hairs, each with a subglobose basal cell; and the long, brown, flexuous hairs scattered over the undersurface of the receptacle. Culture attempts with 2% water agar (WA) and corn meal-malt extract-yeast extract agar (CMMY) succeeded, and the fungus was subsequently grown on these and on corn meal agar (CM) and potato-dextrose agar (PDA) after Lacey and Bridgmon (9). The isolate produced both a *Dichobotrys* anamorphic state and a teleomorphic state with dark brown apothecia which, when grown under room conditions, were identical to those of the parent collection. The collection and culture are similar to the sphaerical-spored *Trichophaea* *brunnea* (Alb. & Schw. ex Fr.) Batra & Batra and to the dark variant of *T*. *abundans*

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[1] Based in part on a dissertation submitted to the Graduate School of Oregon State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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(Karst.) Boudier (1,5,10), but the British Columbia collection differs from both these species in the greater breadth of its ascospores and in the blunt tips of its lower excipular hairs. A long-neglected species, *Patella contradicta* Seaver, closely matches the characteristics of the BC collection (15). Comparison of the BC collection with Seaver's type confirmed the identification, and the BC collection was reported as *P. contradicta* in the Pezizales Checklist (11).

The generic name *Patella* Weber *in* Wigg. ex Seaver is, however, a synonym of the older genus *Scutellinia* (Cke.) Lambotte (4). Species formerly assigned to *Patella* have thus been reassigned to other genera such as *Anthracobia* Boudier, *Cheilymenia* Boudier, *Humaria* Fuckel, *Leucoscypha* Boudier, *Scutellinia*, *Tricharina* Eckblad, and *Trichophaea* Boudier (7); however, Seaver's *P. contradicta* has not been reassigned. In my judgment, it should be transferred to the genus *Trichophaea*. The following new combination and emended description are therefore proposed:

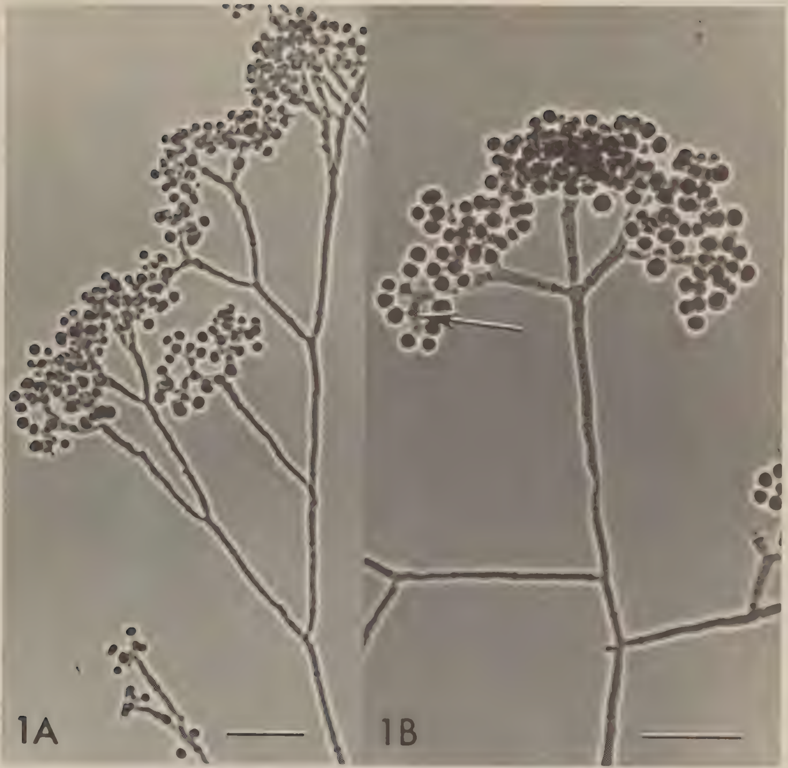
TRICHOPHAEA CONTRADICTA (Seaver) H. J. Larsen, comb. nov.
≡*Patella contradicta* Seaver, Mycologia 32:567. 1940.
Figs. 1,2.

Apothecia gregarious to crowded, sessile, early becoming slightly concave but flattened at maturity, 1-2.5 mm diam; hymenium "Isabelline" (19'i)[1] to "Sepia" (13"m) brown with the apothecial margin darker, elevated, and clothed with an inconspicuous fringe of hairs; lower margin and flank clothed with scattered longer and darker hairs.

Excipular hairs of the upper margin typically single but occasionally grouped in small fascicles, very short, 20-45(-65) X 4-6 µm, hyaline to very light brown, thin-walled, (1-)2-4 celled, narrowing quickly above the 8-10 µm diam swollen basal cell and terminating in a narrowly obtuse to acuminate tip; excipular hairs of the lower margin and flank longer, 80-115(-140) X 5-7 µm, 3-5 celled, "Umber" (15m) brown, more flexuous, also arising from a swollen outer excipular basal cell but more gradually tapering to a narrowly obtuse tip. Ectal excipulum 180-230 µm thick at the base, narrowing to 60 µm thick toward the margin of the apothecium, composed of texture globulosa toward the base of the apothecium with cells (10-)25-60 µm diam and the outermost cells brownish walled; grading into texture angularis for the upper half of the ectal excipulum, with the 15-40 X (5-)10-15(-20) µm cells oriented with their long axis perpendicular to the outer surface. Medullary

[1] Colors after Rayner (12) with Ridgeway (13) equivalents in parentheses.

Figures 1-2. *Trichophaea contradicta*. Fig. 1. *Dichobotrys* anamorphic state by phase contrast microscopy. Bar=50 µm. (A) Typical dichotomously branched conidiophores with conidia. (b) Atypical trichotomously branched conidiophore with catenulate ampullae (arrow). Fig. 2. Teleomorphic state cross-section by brightfield microscopy showing the duplex excipulum. Bar=100 µm.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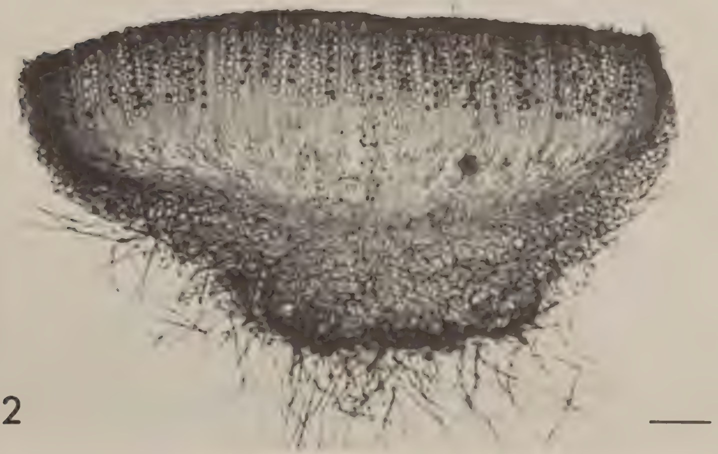
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excipulum 60-100 μm thick, composed of textura intricata with cells 5-8 μm diam.

Asci cylindrical, operculate, J-, eight-spored, 150-170 X 11-14 μm. Ascospores uniseriate, smooth, broadly ellipsoidal to occasionally subsphaerical, (12-)14.5-16(-18) X (8.5-)9.0-10.5(-11) μm, mode 15 X 10 μm, containing one or usually two oil drops and a large DeBary bubble when mounted in lactic acid, lactophenol, or Melzer's reagent; nuclei carminophobic. Paraphyses slender, septate, unbranched, 150-170 X 1.5-2.5 μm; apices enlarged to 5-8 μm diam, usually clavate to spatulate, with the apical cell brownish and containing numerous small oil droplets.

Anamorphic state assigned to Dichobotrys Hennebert. Colonies on CM agar effuse, spreading rapidly, initially white becoming cream-white with age and conidial production, hyphae hyaline, prostrate, septate. Conidiophores erect, 4-6 μm diam, dichotomously (rarely trichotomously) branched 2-5 times beginning at one-half to two-thirds their 180-1000 μm total height, primary branches (15-)30-80(-100) μm long, secondary and subsequent branches 15-25 μm long, the branch length decreasing with each furcation, terminal branches bearing paired, inflated, cylindrical to claviform or sphaerical (rarely catenulate-sphaerical) ampullae which develop 3-5(-8) simultaneous conidial buds and collapse at maturity. Conidia holoblastic, single celled, smooth subglobose to globose, 8-9 μm diam, cream-white to pale ochraceous en masse, with a 1 X 1 μm cylindrical pedicel attached to the conidia at maturity and remaining from the 2-4 μm high X 1(-2) μm diam denticle; cell wall uniformly thickened. Homothallic, with mature apothecia produced 18-21 days after inoculation on CM and CMMY agar.

Colonies on PDA more floccose and with more abundant aerial mycelium, initially white but becoming "Rosy Buff" (13"D) and finally "Flesh" pink (5'd) when grown under daylight fluorescent lights with a 12 hr diurnal off/on cycle. Conidiophores and conidia similar to those on CM agar, but much more abundant and the conidia "Salmon" (11'd) en masse. Few or no apothecia produced on PDA.

Habitat: On burned soil or charcoal in late spring or early summer.

Distribution: Known only from the type locality at the New York Botanic Garden and from Glacier National Park, British Columbia, Canada.

Materials examined: Canada: on burned soil and litter at the edge of a forest fire site, beside Transcanada Highway No. 1 in Glacier National Park, British Columbia, col. H. J. Larsen, 26 June 1971 (HJL F-204; OSC 33,351); United States: on burnt ground, New York Botanic Garden, Bronx, New York City, col. F. J. Seaver, 27 June 1916 (NY) (HOLOTYPE).

Culture: H. J. Larsen 62-I, derived from collection HJL F-204. Culture to be submitted to the American Type Culture Collection.

DISCUSSION

The transfer of Seaver's P. contradicta to Trichophaea is based upon the presence of brown hairs arising from the outer cells of the ectal excipulum, the presence of oil droplets in the ascospores, the lenticular apothecia which lack carotenoid pigments, and the *Dichobotrys* anamorphic state (Fig. 1) (6,7). The genus *Sphaerosporella* (Svrček) Svrček & Kubička shares these characteristics and differs only in having sphaerical spores (3,4,7,14). Korf (7,8) has advocated the merger of *Trichophaea* and *Sphaerosporella* on the basis that the difference in ascospore shape is insufficient to separate these genera. *T. contradicta* supports this tenet since its broadly ellipsoidal ascospores (L:W 1.5) are nicely intermediate between those of species with sphaerical spores (L:W 1.0) and those of species with elliptical ascospores (L:W 1.7-2.9). Korf's view is therefore accepted here and the species is assigned to *Trichophaea* since it has priority if the two genera are merged (7).

The species most closely related to *T. contradicta* appear to be *T. brunnea* and the dark apothecial variant of *T. abundans*. Both of these pyrophilic species are dark brown and have a duplex excipulum and a *Dichobotrys* anamorphic state (1,10,14). Ascospore shape and excipular hair morphology and distribution are the primary differences separating the three species. *T. brunnea* has sphaerical ascospores and excipular hairs which are often fasciculate near the apothecial margin and which lack enlarged basal cells. The holotype of *T. contradicta* has a few small fascicles of excipular hairs at the apothecial margin, but the fasciculation is neither as common nor as obvious as in *T. brunnea*. *T. abundans* has narrower ascospores (L:W 1.8) and longer excipular hairs at the margin (50-80 µm long) and on the lower exterior (80-150 µm long); the basal cell of the excipular hairs of *T. abundans* is also less enlarged than those of *T. contradicta*.

The anamorphic state of *T. contradicta* differs in several respects from the four *Dichobotrys* species described by Hennebert (5). As seen in Table I, the most distinctive characteristic separating the species is the number of conidia produced per ampulla. The conidial sizes and shapes for *D. abundans* Henneb. and *D. sessilispora* Henneb. overlap those for the *T. contradicta* anamorph, but *D. sessilispora* is readily distinguished by its broader pedicel. The degree of conidiophore branching has only limited value as a diagnostic character since it varies with the richness of the medium for *D. abundans* (2); similarly, many conidiophores of the *T. contradicta* anamorph tend to have four to five dichotomies when grown on PDA but only two to three dichotomies when grown on WA. Trichotomously branched conidiophores and catenulate ampullae, like those occasionally observed in the *T. contradicta* anamorph (Fig. 1-B), are reported only for *D. sessilispora* (2) and neither feature is typical for either species. The "Rosy Buff" to "Flesh" pink colonial and "Salmon" pink conidial coloration, observed when the *T. contradicta* anamorph is grown on PDA under 12 hr diurnal fluorescent illumination, contrasts with the ochraceous colors reported for the other species (2,5).

Table I. Characteristics of the anamorphic state of _T. contradicta_ and known _Dichobotrys_ species.

Dichobotrys species	Conidia per ampulla	Conidial size	Conidial shape	Pedicel width	No. of Conidiophore branches
T. contradicta anamorph	3-5(-8)	8-9 μm	subglobose to globose	1(-2) μm	2-5
D. abundans	10-15	8-11 X 7-9 μm	napiform to subglobose	1 μm	3-7
D. brunnea	6-12	12-15 μm diam.	globose	?	2-3
D. parvispora	"numerous"	4-6 X 4-8 μm	napiform to subglobose	1 μm	1-4
D. sessilispora	1-4	(6-)9-10(-14) μm diam.	subglobose to globose	3-4(-7) μm	1-3

I thank the New York Botanical Garden for lending me the type collection of _P. contradicta_. Support during the intial stage of this study was provided by NSF Graduate Traineeship GX 1697.

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MYCOTAXON

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A NEW SPHERICAL SPORED SPECIES OF COPROTUS (PEZIZALES)[1]

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The genus *Coprotus* (Kimbrough and Korf, 1967) includes those species of coprophilous discomycetes with eight or multispored, nonamyloid asci and smooth ascospores with characteristic gaseous inclusions referred to as deBary bubbles. *Coprotus* was placed in the tribe Theleboleae of the Pezizaceae, and a total of six speciew were transferred to the genus. In recent studies of the Pezizales, *Coprotus* is recognized and the tribe Theleboleae is raised to familial rank (Rifai 1968; Eckblad, 1968). However, cytological and developmental studies by Kish (1974) suggest that the genus shows much closer affinities with the Pyronemataceae than with the Thelebolaceae. Morphological and cytochemical similarities between the apical apparatuses of asci in *Pyronema* and *Coprotus* shown by Samuelson (1978) support this view.

According to Eckblad (1968), van Brummelen studied the type of *Leporina multispora* Velenovsky and found it to be identical with *Ascobolus sexdecimsporus* Crouan, the holotype of *Coprotus* Korf and Kimbr. This implied to Eckblad that *Leporina* should be the correct name for *Coprotus*. Kimbrough (1970) discussed the nomenclatural problem in greater detail and pointed out that, in view of the multiplicity of organisms that existed on the type of *Leporina*, the genus was perhaps based on a type consisting of two or more entirely disconcordant elements. He concluded that the unambiguous taxon *Coprotus* should be retained.

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[1] Florida Agricultural Experiment Station Jour. Ser. No. 2363

In a monograph of the North American species of *Coprotus*, Kimbrough, Luck-Allen, and Cain (1972) transferred five more species to the genus and described six new ones. Taking into account observations on these species, they further modified the original generic diagnosis of *Coprotus*. Subsequent to this monograph, the following species have been described, *C. trichosurus* Bell and Kimbrough (1973), *C. baeosporus* Jeng and Krug (1977), and *C. sarengparensis* Thind and Kaushal (1978). These differed largely from previously described species in ascospore size and shape.

During a study of coprophilous fungi on dung samples from California, a species of *Coprotus* was discovered which could not be identified as any of the currently accepted species. This fungus is, therefore, described as a new species.

Coprotus sphaerosporus Gibson and Kimbrough, sp. nov.

(Figs. 1-7)

Apothecia dispersa vel gregaria, sessile, 0.2-0.7 mm in diametro, alba vel fere pellucida, primo globosa demum discoidea, superficies asperita per asci protrudens. Excipulum basalis e textura globosa, e 2-3 strata cellulis compositis, cellulae 5.0-6.5 µm in diametro, cellulae marginales elongatae, 6.0-8.5 x 2.0-3.5 µm. Asci 8-spori, cylindracei vel clavati, e basi attenuati, tholiformis vel aliquanto truncati, 76-89 x 13-19 µm. Ascosporae uniseriatae minus saepe biseriate, globosae vel subglobosae, 8.0-8.5 x 5.5-6.0 µm, unusquisque "deBary bubble" conspicuus praeditae. Paraphyses filiformes, septatae, simplex vel prope basi ramosi, guttulatae, interdum superne leviter inflatae. In fimo equinum.

Holotype: On horse dung from San Bernardino Co., California, N. side of Granite Mts., el. 4200 ft., T. C. Emel, 3/27/75, FLAS F 52105.

Apothecia scattered to gregarious, sessile, 0.2-0.7 mm in diam, white to almost translucent, at first globose, then becoming discoid, surface roughened by protruding asci; basal excipulum of a *textura globosa*, in 2-3 cell layers with cells 5.0-6.5 um in diam; marginal excipulum with cells elongated, 6.0-8.5 x 2.0-3.5 um; asci eight-spored, cylindric to clavate, attenuate at the base, dome-shaped to somewhat truncate, 76-89 x 13-19 um; ascospores uniseriate, less frequently biseriate, globose to subglobose, 8.0-8.5 x 5.5-6.0 um, each with a conspicuous deBary bubble; paraphyses filiform, septate, simple or branched near the bases, guttulate, sometimes slightly inflated at the apices. On horse dung.

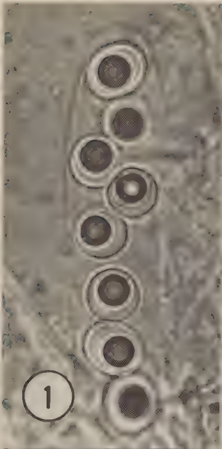
COMMENTS

Coprotus sphaerosporus differs from all other species described in the genus in having spherical spores. All previously known species have ellipsoidal spores. Apothecia of *C. sphaerosporus* (Fig. 4) are similar to those of *C. albidus* (Boud.) Kimbr. and *C. winteri* (Marchal) Kimbr. in that they are white to translucent throughout development. The cells of the medullary excipulum (Fig. 2) are very similar to those of *C. glaucellus* (Rehm) Kimbr. and *C. breviascus* (Vel.) Kimbr., Luck-Allen, and Cain. However, the marginal cells of the ectal excipulum (Fig. 3) are more like those of *C. duplus* Kimbr. and *C. nivius* (Fckl.) Kimbr., Luck-Allen, and Cain. The uniseriate to sometimes biseriate, 8-spored asci (Figs. 1 and 5) are typical of several species, including *C. glaucellus*, *C. leucopocillum* Kimbr., and *C. ochraceus* (Cr. and Cr.) Larsen. The septate, filiform, basally branched paraphyses (Fig. 7) are similar to those of *C. dextrinoideus* Kimbr. Although it shares many common features with other species of the genus, when spores are examined, *C. sphaerosporus* is not likely to be mistaken for any of the known species.

ACKNOWLEDGEMENTS

We would like to thank Dr. Dana Griffin, III for assisting with the Latin diagnosis and Dr. Gerald Benny for reviewing the manuscript and assisting in preparing the photographic plate. We also appreciate Dr. Don Pfister's willingness to review the manuscript.

Figs. 1-7. *Coprotus sphaerosporus*. (1) A mature ascus with spherical ascospores showing conspicuous deBary bubbles, X 1000. (2) Section of apothecium showing cells of the medullary excipulum, X 400. (3) Apothecial section with elongated marginal cells of the ectal excipulum, X 400. (4) A mature apothecium on dung, X 30. (5) An ascus with plasmolyzed, immature spores, X 1000. (6) An empty ascus with attached operculum, X 1000. (7) Septate, filimorm paraphyses, X 1000.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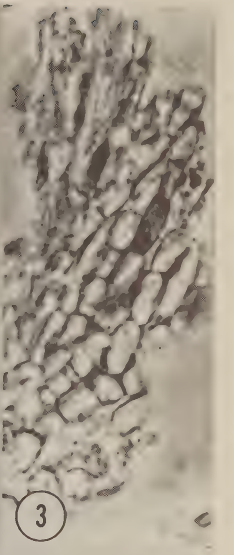
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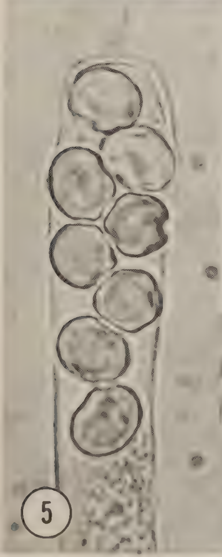
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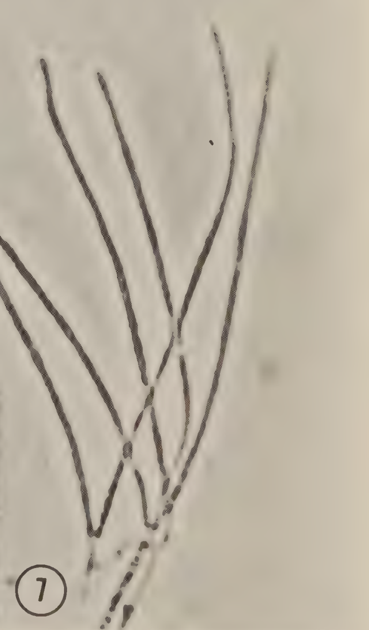
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LATER STARTING POINT BLUES. II.
DUMONTINIA TUBEROSA: THE THORNY THICKETS OF SYNONYMY AND SOME EXAMPLES OF NOMENCLATORIALISM*

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SUMMARY

Six examples derived from a study of the synonymy of Dumontinia tuberosa are used to illustrate that "learning to live with later starting points" yields only frustration for the conscientious mycologist. Later starting points not only fail to avoid pre-starting-point bibliographic work, but create an additional, intolerable bibliographic load, and perniciously create new names (legal fictions). Adoption of a favored status for the "basic books" of Persoon and Fries, coupled with a change of the starting point to 1753, offers great hope for nomenclatural stability.

* "Some have plunged into the thorny thickets of synonymy, floundering amid the multitudinous meticulosities of Nomenclatorialism,[2] from which they rarely emerge unscathed; ....

[2] NOMENCLATORIALISM. An intricate, esoteric art which strives to affix to every living creature (plant or animal) a definite unchangeable Latin label in strict accordance with the very latest views about Scientific Nomenclature. The object of the art was to reach finality; but it has not attained that end, nor can it, so long as the multiplicity of nature is rivalled by the variety of men's minds. A naturalist should take heed lest he become too nomenclatorialistically minded." – W. B. Grove, **British Stem- and Leaf-Fungi**, vol. 2, p. 637. 1937.

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INTRODUCTION

Later starting points were introduced for certain groups of plants, including the fungi, for the purposes of bringing order and simplicity to the citation of names in those groups that Linnaeus (1753) had not adequately treated. Our attempts to follow the later starting-point provisions of the International Code of Botanical Nomenclature (ICBN) (Stafleu, 1978) have demonstrated consistently that rather than reduce the work of taxonomists, these provisions inordinately increase the work load and yield often completely arbitrary results. A single synonymy is considered here in some detail, that of _Dumontinia tuberosa_ (TABLE 1), a species treated by the junior author in her monographic studies of _Sclerotinia_ (Kohn, 1979). Citation of the authorities for the dozen names in synonymy is unnecessarily complex and required untold hours of bibliographic research, most of which was directly the result of later starting-point provisions. We cannot even claim, after our exhaustive search of the literature, that we have correctly cited the names in that Table.

Two early-described fungi have usually been synonymized, _Octospora tuberosa_ Hedwig 1789 (TABLE 1: Rank 1) and _Peziza tuberosa_ _Bulliard 1791_ (Rank 3). The two epithets happen to be the same, but the names rest on different type specimens. A year after Hedwig published his name, Dickson transferred it to _Peziza_ (Rank 2). Bulliard's name, published still a year later, would be a later homonym of _P. tuberosa_ (Hedw.) Dicks. were it not for the provisions of a later starting point, which devalidate all three names. Because these are Ascomycetes [part of the _Fungi caeteri_ cited in ICBN, Art. 13.1 (f)], special status is given to the names used by Fries in the _Systema mycologicum_ 1821-1832. Fries recognized Bulliard as the author of the name he accepted, _Peziza tuberosa_, and he considered _Octospora tuberosa_ Hedw. to be a taxonomic synonym of it. We may consider that under the ICBN Fries thereby sanctioned the use of Bulliard's name.

TABLE I: THE SYNONYMY

Rank by date	
12	Dumontinia tuberosa (Bull. ex Mérat) Kohn, Mycotaxon **9:** 433. 1979.
3	≡ [Peziza tuberosa Bull., Hist. champ. France p. 266, pl. 485, Ill. 1791 (pre-starting point; not validly published [ICBN, Art. 13.1 (f)], "later homonym" of P. tuberosa (Hedw.) Dickson 1790).]
4	≡ Peziza tuberosa Bull. ex Mérat, Nouv. fl. envir. Paris ed. 2, **1:** 24. 1821 (**sanctioned** [ICBN, Art. 13.1 (f)] by Fries, Syst. mycol. **2**(1): 58. 1822, 2(2): 612. 1823).
8	≡ Rutstroemia tuberosa (Bull. ex Mérat) Karst., Bidrag Kännedom Finlands Natur Folk **19:** 105. 1871.
10	≡ Hymenoscyphus tuberosus (Bull. ex Mérat) Phill. (**ut** "Hymenoscypha tuberosa"), Man. Brit. discomyc. p. 113. 1887.
11	≡ Whetzelinia tuberosa (Bull. ex Mérat) Korf & Dumont [**ut** "(Hedw. ex Mérat)"], Mycologia **64:** 250. 1972.
1	= [Octospora tuberosa Hedw., Descr. micr.-anal. musc. frond. **2:** 33. 1789 (pre-starting point; not validly published [ICBN, Art. 13.1 (f)]).]
2	≡ [Peziza tuberosa (Hedw.) Dickson, Fasc. pl. crypt. brit. **2:** 25. 1790 (pre-starting point; not validly published [ICBN, Art. 13.1 (f)]).]
6	≡ Peziza tuberosa (Hedw.) Dickson ex Ficinus & Schubert (**ut** "Diks."), Fl. Dresden Ed. 2, **2:** 456. 1823 (validly published later homonym, **illegitimate**), **not** P. tuberosa Bull. ex Mérat 1821.
7	≡ Sclerotinia tuberosa Fuckel [**ut** "(Hedw.)"], Jahrb. Nassauischen Vereins Naturk. **23-24:** 331. 1870 (a **new name** [ICBN, Art. 72.1 Note 1]).
9	≡ Phialea tuberosa Gillet (**ut** "Hedw."), Champ. France discomyc. p. 97. 1881 (1882?) (a **new name** [ICBN, Art. 72.1 Note 1]).
5	= Macroscyphus tuberosus [Hedw.? Bull.?] S.F. Gray, Nat. arr. Brit. pl. **1:** 672. 1821.

NOTES ON THE TABLE: The synonymy is essentially a revised arrangement of the early taxonomic synonyms and the later nomenclatural synonyms from Kohn (1979); later taxonomic synonyms given there, of no nomenclatural significance, are intentionally omitted here.

An examination of the literature will show the reader that in almost no instance have any of the post-1820 names appearing in TABLE 1 been given the author citations attributed to them there, simply because the provisions of later starting points are too complicated for even the best-intentioned workers to follow. Not a single textbook, not a single flora, not a single monograph (save that of the junior author) uses what we consider to be the "correct" authorities under ICBN. Any claim that later starting points lead to stability in names and author citations is wholly inconsistent with these results.

By a series of "examples," we hope to lead the reader to a better understanding of how later starting points have caused and will cause havoc in nomenclature. W. B. Grove, to whom we fondly dedicate this paper, had it right: there are indeed "thorny thickets of synonymy" and "multitudinous meticulosities of Nomenclatorialism" (Grove, 1937: 637).

AN HISTORICAL PERSPECTIVE: THE 1753 STARTING POINT

When the International Botanical Congress of 1867 adopted its first Code, the Lois de la Nomenclature Botanique prepared by Alphonse L. P. P. de Candolle, the Linnean binomial system was adopted, but no "starting point" was established. Nomenclature was not to be seriously discussed again at an International Botanical Congress until the Paris Congress of 1900 moved that the subject of nomenclature be given careful consideration at the Vienna Congress of 1905. The next five years saw a flurry of activity, including publication of the unfortunate "American Code" in 1904, which was proposed for complete substitution for the laws of 1867. At the Vienna Congress the American Code gained few adherents, and the new set of laws retained practically the original form, with some alterations and additions. The rules were seen to apply principally to vascular plants, and the special problems in connection with cryptogams were placed in the hands of committees, to be given further consideration at the Brussels Congress in 1910. A starting point for vascular plants was designated at the 1905 Congress: Linnaeus's Species Plantarum ed. 1 (1753).

MORE HISTORY: THE LATER STARTING-POINT CONCEPT AND THE SLIDING DATE

It was at the Brussels Congress of 1910 that decisions were made on appropriate starting points for cryptogams. Myxomycetes and Lichens have the same starting point as do vascular plants: Linnaeus's Species Plantarum, ed. 1 (1753). Fungi were to start with Fries's Systema Mycologicum 1821-1832, except for Ustilaginales, Uredinales and Gasteromycetes which date from Persoon's Synopsis Methodica Fungorum 1801.[1]

The question of lists of nomina conservanda among cryptogams, also on the agenda for consideration at Brussels, was put off for

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[1] The most remarkable decision, perhaps, reached by the special committees at Brussels, was to adopt Hirn's 1900 Monographie und Iconographie der Oedogoniaceen as a starting-point book, fewer than ten years after its appearance.

for the 1915 Congress, since it was evidently impossible to compile such lists before the dates of priority were fixed. World War I intervened, and the next International Botanical Congress, in Ithaca, 1925, did not take up nomenclature.

The Cambridge Congress of 1930 and the Amsterdam Congress of 1935 did not change the starting points proposed for fungi in 1910. It was not until 1950 that the next International Botanical Congress was held, following World War II, in Stockholm. At it, a distinction was made between starting-point **dates** and starting-point **books** that proved of major significance in citation of names of fungi.

Each of the Codes from 1910 to 1935 had listed a year (or a series of years), and then the name of an author and the title of a book, book-series, or monographic article. The major fungal entry, that of Fries's Systema Mycologicum, had the dates 1821-1832, often referred to in the literature as a "**sliding date.**" Just how that 12-year span was to be treated was not spelled out in the Codes, nor was there any agreement among practicing mycologists. The dates on which the various parts of the Systema had appeared was established with fair precision: volume **1** in 1821, **2**(1) in 1822, **2**(2) in 1823, **3**(1) in 1829, and **3**(2) and the Index in 1832. Fries's Elenchus Fungorum, both volumes appearing in 1828, was a supplement to the Systema, but whether or not it was a part of the "starting-point book" was neither spelled out in the Codes nor was there general agreement on its status among mycologists.

Some mycologists treated the later starting point of Fries's Systema to mean that each taxonomic group started with its first treatment in that series. Thus most Basidiomycetes were held to begin their nomenclature in 1821, since they were, for the most part, treated in volume **1**. Among Discomycetes, for example, the Geoglossaceae, treated in volume **1**, also had an 1821 starting date; many others date from 1822, with still others starting (along with most Pyrenomycetes) in 1823, etc. Some mycologists held to an 1821 start for all of these fungi, while others held that the 1832 index should be the deciding date. Confusion reigned, of course, since different interpretations gave rise to different name choices or author citations.

It is only fair to point out that the basic reason for choosing the works of Persoon and of Fries was that their work represented the first major comprehensive treatments of fungi. Both men were considered to be the real "fathers of mycology" as we know it. The confusion that existed in the earlier literature had been sorted out to a great extent in these two works, and the mycologists who voted for these works as starting-point volumes in Brussels in 1910 probably chose as wisely as it would be possible to choose today.

EXAMPLE 1: THE 1950 STOCKHOLM CONGRESS (DATES, NOT BOOKS, AND THE NON-ACCEPTANCE OF THE FILTER SYSTEM)

The most significant change in later starting-point procedures grew out of a decision implemented at the Stockholm Congress to assign precise dates to starting-point books. The exact date of publication of many books was not known, and **arbitrary** dates were chosen for those starting-point books where the actual date was uncertain. Linnaeus's *Species Plantarum* ed. 1 was arbitrarily dated 1 May 1753. Persoon's *Synopsis* was arbitrarily dated 31 December 1801, and the first volume of Fries's *Systema* was arbitrarily dated 1 January 1821.

For mycologists these new dates had profound effects. The dating of Persoon's work clearly made all other works published in or before 1801 **pre-starting-point**. Similarly, the choice of 1.1.1801 for volume 1 of Fries's *Systema* made any publication appearing in 1821 **post-starting-point** (thus validating the publication of S. F. Gray's *A Natural Arrangement of British Plants*, over which much controversy had existed as to whether it was pre-Friesian or post-Friesian).

Starting points were thus to be dates, **not** books. For nearly all groups of plants a particular **book** was deemed to have been published on the starting-point date. This was not true, however, of certain algal groups[2] and of *Fungi caeteri*. The mycologists at Stockholm, aware that most of the *Fungi caeteri* were not included in volume 1 of the *Systema*, and that the starting-point *date* did not correlate with any starting-point *book* for such fungi, adopted a complicated, confusingly worded concept aimed at giving privileged status to Fries's names; they included for the first time the *Elenchus* under the umbrella of priviledged names:

> "Art. 23, f. FUNGI CAETERI, 1 Jan. 1821 (Fries, *Systema Mycologicum* Vol. 1). Vol. 1 of the *Systema* is treated as having appeared on 1 Jan. 1821, and the *Elenchus Fungorum* (1828) is treated as part of the *Systema*. Names of FUNGI CAETERI published in other works between the dates of the first (Vol. 1) and last (Vol. 3 part 2 and index) parts of the *Systema* which are synonyms or homonyms of any of the FUNGI CAETERI included in the *Systema* do not affect the nomenclatural status of names used by Fries in this work."

This remarkable wording was the result of a compromise among members of the Special Committee for Fungi and Lichens, who had not seen fit to adopte the "filter" system proposed by M. A. Donk and others. That system had as its focus a simple process for determining name usage: one would first turn to the indices of the *Systema*, or of Persoon's *Synopsis* for the groups concerned there, to determine if the starting-point author had adopoted a name (or had placed it in synonymy). If the name was accepted in the starting-point book, one's literature search was over, and the name dated from its appearance there. If the name was lacking or unaccepted, it's date status would be from the first acceptance *after* the starting-point date. The filter system thus gave protected status to the names in Fries's and Persoon's major works, would have cut bibliographic work for most of the names accepted in these works, and would have given us two books that would have covered the great majority of older, pre-starting-point names.

The net result of the 1950 decision (and the rejection of the "filter" system) was to multiply the problems of citing names and au-

[2] For these algae arbitrary dates were finally assigned at the Leningrad Congress in 1975. The "sliding-dates" problems for Nostocaceae were solved by assigning one arbitrary early date to all parts of multi-year treatments. Had mycologists opted for all parts of the *Systema* arbitrarily dated 1.I.1821, theirs would have been a similar solution.

thorities correctly, not particularly for Basidiomycetes, but significantly for Ascomycetes, Fungi Imperfecti and "Phycomycetes." It is no longer sufficient to know that Fries may have adopted a certain name for a Pyrenomycete or Discomycete in 1823; if one finds such a name, one is aware it has a priviledged status ("do not affect the nomenclatural status of names used by Fries in this work"), but the starting point for the name is **not** it's use in the Systema in 1823, but is 1.1.1821. **This fact is the basis for a huge and unintended burden being placed on mycologists who attempt to follow the Code.** Failure to comprehend what is involved in bibliographic "busy-work" in searching from 1.1.1821-to-date-of-treatment-in-the-Systema is the main reason that those who have objected to changing the present wording have continued their stance.

EXAMPLE 2: THE PROTOLOGUE, WHY LATER STARTING POINTS FAIL TO "WIPE THE SLATE CLEAN," AND LECTOTYPIFICATION OF PRE-STARTING-POINT NAMES

Those naïve in nomenclatural procedures have assumed that the establishment of a starting-point date automatically "wipes the slate clean" in that materials published prior to the starting point need no longer to be consulted; the old, rare books, available in only a few libraries, can be ignored, since the names they contain are ruled "not validly published." This is not true, because though nomenclature for a group begins with a specific date, taxonomy begins with the earliest recorded writing. An exceptionally important nomenclatural concept is that of the **protologue**, defined in ICBN as:

"* Protologue (from πρωτοϛ, first; λογοϛ, discourse): everything associated with a name at its first publication, i.e. diagnosis, description, illustrations, references, synonymy, geographical data, citation of specimens, discussion, and comments."

When pre-starting-point names are validly published by a post-starting-point author, he/she may or may not provide a description or diagnosis, but usually does give some reference to the pre-starting-point name (even if only indication of the name of the pre-starting-point author). **Typification** of the validly published name is a crucial nomenclatural act with immense implications concerning what name must be applied following taxonomic decisions. Articles 7.12 and 7.13 of the ICBN bear specifically on the question of the protologue in later starting-point situations:

"7.12 The type of a name of a taxon assigned to a group with a nomenclatural starting-point later than 1753 (see Art. 13) is to be determined in accordance with the indication or description and any other matter accompanying its first valid publication (see Arts. 32-45).

"7.13 When valid publication is by reference to a pre-starting-point description, the latter must be used for purposes of typification as though newly published."

The effect of these portions of Art. 7 is to **require** consultation of the pre-starting-point literature cited by the post-starting-point author. Instead of the slate having been wiped clean, such materials are "newly published" as of the date of the validating, post-starting-point author having mentioned them at all. The need to consult the older literature is thus often undiminished by provision of later starting points, since mere reference to it in the validating post-starting-point publication brings it "back to life."

It thus becomes impossible to consider any of the names in post-starting-point publications, including the Synopsis and the Systema, as standing on their own if they contain references (nearly all do) to earlier literature. Note that the protologue includes "everything" that appears in the first publication (and since pre-starting-point names are not validly published, the definition's "first publication" can only mean "first valid [i.e., post-starting-point] publication"). Art. 7.13 specifically takes up the situation where the validating author gives no description or diagnosis: the pre-starting-point description becomes crucial then in deciding on the type. Similarly, Art. 7.12 admonishes us to determine the type of a name not only from indications or descriptions accompanying the first valid publication, but from "any other matter accompanying" that publication, i.e., the total protologue (including the references and thereby everything that was written therein of the older literature).

Persoon and Fries did not work solely as creators: their works stand on the accumulated research of their forebearers. The Code does not destroy that historical basis by providing later starting points. The older books must still be consulted to understand what synthesis Persoon and Fries may have done to bring order to the literature of their past.

The importance of the protologue is particularly crucial when one remembers that the arbitrary starting-point date of 1.1.1821 gives special status to many papers published in 1821 and soon thereafter, papers that might well be forgotten, since they are often only local floristic lists. Frequently such compilers of names had no specimens, may never have seen the fungus at all but merely have compiled the literature citation. If we were forced to select a type specimen from non-existant material, or from a compiler's misidentifications, we would be in difficult straits indeed. But because the pre-starting-point name was cited as part of the protologue, we are free to select a type from the original material (if it exists), even though the material and its basis in publication is pre-starting-point: it becomes post-starting-point by virtue of the protologue provisions of the Code.

EXAMPLE 3: ON LEGAL FICTIONS CREATED BY LATER STARTING POINTS: THE LOSS OF INFORMATION BY SUPPRESSING CITATION OF THE ORIGINAL AUTHOR, THE "TRANSFER" OF PRE-STARTING-POINT NAMES, AND OTHER PERNICIOUS PHENOMENA

In little of the literature dealing with later starting points has any attention been drawn to what we consider to be one of the most horrendous results of this system.

Nomenclaturally aware mycologists understand that the Code permits two methods of citing authorities for names that were originally pre-starting-point. In the words of the ICBN, Recommendation 46E,

"46E.1 When an author who first validly publishes a name ascribes it to an author who published the name before the starting point of the group concerned (see Art. 13), the author citation may include, when such indication is considered useful or desirable, the name of the pre-starting-point author followed by ex as in Rec. 46C.

Examples: Lupinus L. or Lupinus Tourn. ex L. - Boletus piperatus Fr. or

B. piperatus Bulliard ex Fr. – *Euastrum binale* Ralfs or *E. binale* Ehrenb. ex Ralfs."

An examination of TABLE 1 will reveal that we have retained the pre-starting-point authors' names in ranks 4, 6, 8, 10, 11, and 12, since without doing so it would be impossible to tell from the author citation where the probable type of the name resides (perhaps the only valid reason for citing an author's name at all). If we suppress the "ex" as Rec. 46E.1 allows, we will note that in Rank 4 Mérat, a mere compiler of Parisian fungi, is the originator of the name *Peziza tuberosa* Mérat 1821, and that his name can appear alone within the parentheses of the transfers in Ranks 8, 10, 11, and 12. Such a species name is a **legal fiction**: Mérat had no intention to introduce a novelty to science. Has anyone ever seen a Mérat specimen? He was a follower of Persoon, not an innovator. We have been unable to find any book or article that credits Mérat, and not Bulliard, with this epithet, in any combination. Were it not for the later starting-point provisions, there would be no such species name as *P. tuberosa* Mérat; what a pity Rec. 46E.1 commends such a citation.

In Rank 6 we find another entry, which can be "simplified" under Rec. 46E.1 to read "*Peziza tuberosa* Ficinus & Schubert 1823." They, too, of course had no intention of giving mycology a "new species," but were merely the first after 1.1.1821 to list a species, described in 1789 by Hedwig as *Octospora tuberosa*, within the genus *Peziza*. The transfer to *Peziza* was not even theirs: they were reporting Dickson's transfer of 1790 (Rank 2). Because of later starting-point provisions, *P. tuberosa* Ficinus & Schubert is a later homonym of Mérat's name, both being legal fictions.[3]

It is not even clear whether under the Code we can speak of "transfers" of pre-starting-point names. Could Dickson (Rank 2) really transfer Hedwig's name (Rank 1) if neither is validly published? Can one cite the authorities for the Ficinus & Schubert name (Rank 6) other than we have done and still retain some indication of the nomenclatural typification of the name? Can one really say that Bulliard's name (Rank 3) is a "later homonym" of Dickson's (Rank 2)? We felt obliged to put quotation marks around "later homonym" under Rank 3, since both are not validly published names, and thus **not names at all** under the Code (ICBN, Art. 6.6).

There are still two other legal fictions in the synonymy that come about by an interaction of later starting-point provisions and Art. 67.1 Note 2 and Art. 72.1 Note 1. These two notes point out that one cannot transfer an illegitimate epithet, but if there is no obstacle to the employment of the epithet in a new position or sense, it may be adopted but takes on a different authority. One of the examples under Art. 72.1 Note 1 is both mycological and instructive:

"*Uredo aegopodii* Strauss (Ann. Wetter. Ges. 2(1): 101. 1810) is a later homonym of *U. aegopodii* Schumacher (Enum. Pl. Saell. 2: 233. 1803). Röhling transferred the former to the genus *Puccinia*; the resulting combination (Deutschl. Fl. ed. 2. 3(3): 131. 1813) is treated as new and should be written *P. aegopodii* Röhl., not as *P. aegopodii*

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[3] Note, too, that *P. tuberosa* (Hedw.) Dicks. (Rank 2) would be the correct name, dating from 1790, and *P. tuberosa* Bull. (Rank 3) the later homonym, dating from 1791, were it not for the provisions of later starting points.

(Strauss) Röhl."

Thus we find the citation of *Sclerotinia tuberosa* Fuckel for the entry in Rank 7. Fuckel intended to transfer Hedwig's *Octospora tuberosa* to his new genus, *Sclerotinia*. Hedwig's name has no nomenclatural status, being pre-starting-point. Ficinus & Schubert's use of the epithet in 1823 (Rank 6) did not constitute a reprieve for Hedwig's epithet, since their *P. tuberosa* (Hedw.) Dicks. ex Ficinus & Schubert is illegitimate because it is a (legally fictitious) later homonym of *P. tuberosa* Bull. ex Mérat of 1821. Fuckel appears to have been the first to attempt to transfer the Hedwig epithet following Ficinus and Schubert. The combination is thus not to be written as *S. tuberosa* (Hedw.) Fuckel, or as *S. tuberosa* (Hedw.) ex Fuckel, but as *S. tuberosa* Fuckel. This particular legal fiction has never, so far as we know, been adopted by anyone other than the junior author in her attempt to follow the Code (Kohn, **1979**).

Our synonymy provides a final legal fiction, the citation for *Phialea tuberosa* Gillet (Rank 9). Gillet, like Fuckel in the preceding example, wanted to transfer Hedwig's species, this time to *Phialea*. For the same reasons, such a transfer is prohibited under the Code. But again Art. 72.1 Note 1 comes into play, for there is no obstacle to the employment of the epithet "tuberosa" in *Phialea*. So, again, the Code would have us suppress the original author, and to substitute Gillet. We gain still another insight into the operations of this part of the Code: note that even though Hedwig's name took on new life in 1870, now credited to Fuckel (Rank 7), another author, Gillet, gets credit for the same species in *Phialea* (Rank 9). All three are of course based on Hedwig's type specimen. [Had Gillet mentioned Fuckel's name, it would have been a new combination, *Ph. tuberosa* (Fuckel) Gillet.]

Are we overstating our case in terming these legal fictions, never emplyed by anyone except those determined to follow the Code, to be examples of a "pernicious phenomen"? We think not. If nobody is citing the names correctly, **something must be wrong.**

EXAMPLE 4: TRIVIAL FLORAS, A BIBLIOGRAPHER'S NIGHTMARE, A BOOKSELLER'S DREAM

The Stockholm decision of 1950 to set the date of 1.1.1821 as starting point for *Fungi caeteri* probably did more for the rare book trade than any other Botanical Congress action in memory. Immense nomenclatural significance suddenly descended upon a host of seldom-consulted works that appeared in the period 1821-1832. No longer was it possible to consider Fries's *Systema* as the place of validation of names that appeared therein. True, the names in the *Systema* still had favored status, but author citations would have to change. Where the senior author had written *Arachnopeziza aurelia* (Pers. ex Fr.) Fuckel in his thesis (Korf, **1952**), he would now be obliged to write *A. aurelia* (Pers.) Fuckel; where he had written *Eriopezia caesia* (Pers. ex Fr.) Rehm he would need to change to *E. caesia* (Pers. ex Gray) Rehm [or even to *E. caesia* (Gray) Rehm under Rec. 46E.1]. He was now obliged to check *every* book and paper on fungi appearing between 1.1.1821 and late 1822 to find who *first* accepted the epithet concerned, if indeed anyone had done so *prior* to Fries's late 1822 "sanctioning" of *P. aurelia* and *P. caesia*.

The senior author had the very good fortune to become a friend of one of mycology's foremost experts on nomenclature, and a bibliographer of great repute, Dr. D. P. Rogers, at the New York Botanical Garden. Rogers quickly appreciated the senior author's interest in nomenclature, and early in the 1950's supplied him with a list of early mycological books and papers spanning the years 1821-1833; in 1955 he supplied a supplementary list. These two lists embodied much of Roger's bibliographic work on sequentially dating the various works that appeared in the 1821-1833 period, for Rogers was aware of how significant these works are in reaching a correct author citation under the Code. They have been a bible of sorts for the senior author during the ensuing quarter century. Of course the lists are incomplete, of course there is now more precise dating known for some of the items on the lists. But they did serve to give some insight into what the earliest valid name might be. The debt to Rogers is freely acknowledged here.

Another of the senior author's friends has an equally compelling claim to nomenclatural fame in matters of later starting points: Ronald H. Petersen. His work led him to a different conclusion than had ours, namely that a good index to the 1821 epithets and their pre-starting-point history would show that retention of the 1.I.1821 starting point was the only logical way to proceed, and would not be any great burden. To this end he published the results of a massive bibliographic study of those works published within the year 1821. (Why he restricted himself to this one year is not fully explained.) His papers (Petersen, **1975a**, **1975b**, **1976a**, **1976b**, **1977**) are a masterful compilation not only of the papers of that year, but also of the pre-starting-point works he consulted and from which the 1821 citations often took their roots. Despite his scholarship and diligence, he, too, like Rogers, was unable to sequentially date every article and book that appeared in 1821 (Petersen, **1975a**, **1976a**). At least one has since been shown quite conclusively to have been published in 1820, thus making it pre-starting-point. Whenever one of these unsequenced 1821 sources has a name of interest and a second 1821 author has also used the name, there is of course no way to determine which to cite. And despite Petersen's valiant efforts, we have discovered with our work with Discomycetes that all too often no 1821 author has picked up the epithet, so we must turn to the 1822 (and, for epithets in Fries's Systema **2**(2), to 1823) literature which Petersen did not consider. Then Rogers's lists have come in useful, though we suspect the lists are incomplete. For 1822 he provided only six references [of which four are partially sequenced (a fifth can be accurately dated from the recent Taxonomic Literature ed. 2 by Stafleu and Cowan, (**1976**)]. For 1823 Rogers's lists include only four entries, two of which are sequenced (again Stafleu and Cowan allow dating for one of the two unsequenced entries, but the important date, that of Fries's Systema **2**(2) is uncertain).

In addition to the 25 or 26 1821 papers noted by Petersen (**1975a**), a mycologist ought to have at hand all of the 1822 to early 1832 literature if citing authorities for fungi is to be certain, even if the names appear in Fries's Systema. That no library in the world possesses such a complete treatment almost goes without saying. No serious attempt that we know of, save Rogers's lists, has ever been directed at the 1822-1832 literature. No listing by epithet for that 11-year period has been undertaken as Petersen did so well for the single year, 1821. Whenever you attempt to follow the Code, and are using post-1821-pre-1833 names, your only hope is to cross your fingers and hope for the best that you have somehow caught the earliest use of any epithets mentioned. With such a sense of inadequacy hanging over every mycologist, something must be wrong.

EXAMPLE 5: ON JUGGLING AUTHORITIES

The synonymy in TABLE 1 has five instances where we have "juggled" the author citations significantly from the way they were published. In addition to the "legal fictions" discussed in Example 3 above (Ranks 4, 6, 7, and 9), the case of juggling in Rank 11, authors cited for *Whetzelinia tuberosa*, requires further comment.

When Korf and Dumont (1972) proposed the name, they cited it as "*Whetzelinia tuberosa* (Hedw. *ex* Mérat) Korf & Dumont." This was a clear error, since Mérat had cited only Bulliard as the authority for the epithet. Why, then, did Korf and Dumont cite Hedwig as authority? They consulted Fries's treatment in the *Systema* 2(1), where no authorities are listed, and where both Hedwig's and Bulliard's pre-starting-point names are synonymized. They reasoned (incorrectly) that since Hedwig's was the older name, Fries chose that one (the senior author takes the blame for this error); what Korf and Dumont failed to do was to consult the index in 2(2), where the entry reads "*Peziza tuberosa* Bull.", as it is also in 3 (index). What we have done in Rank 11 is to juggle the authorities they cited, but whether we are justified in doing so is not fully clear, since now we imply that it was a name based on a Bulliard type, not a Hedwig type, that was transferred. But their error in citing Hedwig *and* Mérat (and thus Bulliard) leaves open the question of what they did transfer; obviously they wanted to transfer the correct epithet (that sanctioned by Fries). Whether our juggle of authorities is acceptable we leave to others to argue. (If our final conclusions in this paper are accepted, the point becomes moot.)

A somewhat similar juggle of authorities can be seen in Dennis's (1956) citation of the combination we have in Rank 10. He cites this as "*Hymenoscypha tuberosa* ([Hedw.] Fr.) Phill." When one consults Phillips's book, one finds the entry as "*H. tuberosa* (Bull.)" both on page 113 and in the index. Dennis similarly cited "*Rutstroemia tuberosa* ([Hedw.] Fr.) Karsten" for the correct citation given in Rank 8.

One additional entry in our synonymy requires serious consideration, that of Rank 5. We have indicated this as a taxonomic synonym, and our entry, "*Macroscyphus tuberosus* [Hedw.? Bull.?] Gray" tells the story as we now see it: we cannot determine from Gray's treatment *which* epithet he transferred to *Macroscyphus*. Gray's (1821) entry reads:

> "5. *Macroscyphus tuberosus*. *Tubercus long-funnel*.
> *Root* tuberous, irregular; *stem* very long; *cup* rather small, funnel-shape, chestnut or bay.
>
> Peziza tuberosa, *Dickson Crypt*. 2, 25; *Sowerby Fungi*, 63; *Persoon Syn*. 644.
>
> In woods; April."

None of the three references are to Hedwig or to Bulliard. Each can be traced, however. The Dickson reference predates Bulliard, and must be to Hedwig; Sowerby's reference again leads to Dickson (i.e., Hedwig), but also to Withering (**1792**), which in turn synonymizes (for the first time) Hedwig's and Bulliard's names; Persoon's reference again leads to both Hedwig and Bulliard, as the synonymy is accepted there, too. Which epithet did Gray transfer?

EXAMPLE 6: 1753 AS THE STARTING POINT, WITH PROTECTED STATUS FOR THE NAMES IN THE BASIC BOOKS OF PERSOON AND FRIES

The senior author, as a member of the International Association's Special Committee for Fungi and Lichens, and also a member of the Subcommittee on Later Starting Points of the International Mycological Association's Nomenclature Committee, has actively supported a change in the starting point for Fungi caeteri, and has openly pushed for adoption of 1 May 1753 (Linnaeus, Species Plantarum ed. 1) as the logical date. In the several years since he began his advocacy (see Hennebert and Korf, **1975**), he has come to the conclusion that merely beginning with 1753 will not answer all our problems, nor will it necessarily simplify them. But a proposal originally put forth by the Czechoslovakian mycologist, Z. Pouzar, to treat Persoon's Synopsis and Fries's Systema (inclusive of the Elenchus) as "basic books" makes so much sense that he now fully supports the concept of Pouzar, which has been slightly modified by our Belgian colleague, V. Demoulin, among others on the Subcommittee. It is instructive to use the same synonymy we have been discussing to see what would happen to the names and author citations if 1753 were adopted without the provision of a "basic books" filter-system (TABLE 2) and with such a system (TABLE 3).

A simple return to 1753 causes, for this species, a major upheaval (TABLE 2). Hedwig's name, being the oldest, should have been used by Kohn in Dumontinia. But it cannot now be transferred there because Kohn (**1979**) transferred Bulliard's epithet to the genus (TABLE 2, Rank 10); and Art. 63 rules that a name is **illegimate** if the taxon to which it was applied, as circumscribed by its author, included the type of a name or epithet which ought to have been adopted. The combination D. tuberosa would be illegitimate and would need to be rejected, and we would be forced to coin a new epithet for the species when treated in Dumontinia.

Note that we are still plagued by legal fictions and name juggles: Bulliard's illegitimate epithet took on new life and a new author citation when Karsten picked it up in 1871 without mentioning Hedwig. When Phillips and Kohn transferred Bulliard's epithet, they both cited Karsten's name, and thus can be held to have transferred the now valid epithet, but their combinations are illegitimate on another ground: they included Hedwig's name in their synonymy, and thus did not adopt the earliest available epithet.

On the other hand, if special status is still given to the names accepted in the "basic books" of Persoon (for Uredinales, Ustilaginales, and Gasteromycetes) and Fries (for Fungi caeteri), it appears our problems are greatly simplified (TABLE 3). Reintroduction of M. A. Donk's ": Pers." and ": Fr." notation for 'sanctioned' names is very desirable. Bulliard's epithet, accepted by Fries, becomes the correct one to use. The only unavailable name in the synonymy is

TABLE 2

1753 STARTING DATE ONLY

Rank by date		
11		*Dumontinia* [new epithet required] Korf & Kohn 1980
1	≡	*Octospora tuberosa* Hedw. 1789.
2	≡	*Peziza tuberosa* (Hedw.) Dicks. 1790.
5	≡	*Sclerotinia tuberosa* (Hedw.) Fuckel 1870.
7	≡	*Phialea tuberosa* (Hedw.) Gill. 1881 (1882?).
9	≡	*Whetzelinia tuberosa* (Hedw.) Korf & Dumont 1972.
3	=	*Peziza tuberosa* Bull. 1791 (validly published later homonym, illegitimate), not *P. tuberosa* (Hedw.) Dicks. 1790.
6	≡	*Rutstroemia tuberosa* Karst. 1871 (a new name).
8	≡	*Hymenoscyphus tuberosus* (Karst.) Phill. 1887 (illegitimate, Art. 63, ICBN)
10	≡	*Dumontinia tuberosa* (Karst.) Kohn 1979 (illegitimate, Art. 63, ICBN)
4	=	*Macroscyphus tuberosus* Gray 1821.

TABLE 3

1753 WITH PERSOON AND FRIES AS "BASIC BOOKS"

Rank by date		
10		*Dumontinia tuberosa* (Bull. : Fr.) Kohn 1979.
3	≡	*Peziza tuberosa* Bull. 1791 : Fries 1822, 1823, non *P. tuberosa* (Hedw.) Dicks. 1790.
6	≡	*Rutstroemia tuberosa* (Bull. : Fr.) Karst. 1871.
8	≡	*Hymenoscyphus tuberosus* (Bull. : Fr.) Phill. 1887.
1	=	*Octospora tuberosa* Hedw. 1789.
2	≡	*Peziza tuberosa* (Hedw.) Dicks. 1790 (unavailable: Art. 13.1 (f), ICBN, not *P. tuberosa* Bull. : Fr.)
5	≡	*Sclerotinia tuberosa* (Hedw.) Fuckel 1870.
7	≡	*Phialea tuberosa* (Hedw.) Gill. 1881 (1882?).
9	≡	*Whetzelinia tuberosa* (Hedw.) Korf & Dumont 1972.
4	=	*Macroscyphus tuberosus* Gray 1821.

Peziza tuberosa (Hedw.) Dicks., which is disqualified because Fries sanctioned the use of another author's later homonym. Significantly, too, the legal fictions which we complained so bitterly about in Example 3 above have miraculously disappeared. Fuckel and Gillet were free to transfer Hedwig's epithet (TABLE 3, Ranks 7, 9); so, too, were Korf and Dumont (Rank 9) and nobody has to resort to author-juggling to correct their "mistake" in citing the validating author. And we can forget all about those other legal fictions, the "new" names unintentionally coined by post-starting-point authors. The floras of Mérat and of Ficinus and Schubert can be replaced on the shelves, for we have no need to consult them (nor any of the score or more of 1821-1822 books we had to consult just to be certain we had really picked up the first post-1821 validating author).

CONCLUSION

The study of the synonymy of *Dumontinia tuberosa* leaves little doubt in our mind that continuance of the present provisions of a later starting point for *Fungi caeteri* is intolerable. Wasted hours in the bookstacks do not even yield consistent results. Many unanswered questions plague us about whether pre-starting-point names are even names, and about just who first validated a name after the starting point, questions that may be impossible to answer. What facts can we deduce? We note:

1. Later starting points do not relieve us of the necessity to consult old, pre-starting-point books.

2. Later starting points force us to examine scores of unimportant papers spanning 1821-1832 (and even after) merely to determine who first after an arbitrary date used a name already well-established in the literature.

3. Later starting points generate additional names in our synonymies which are merely legal fictions.

4. Later starting points demonstrably produce author citations never before used: in our example, we know of no author who has ever cited any of the post-starting point names in the synonymy correctly (except for the junior author's nomenclatorialistically exact thesis study).

5. Adoption of a 1753 starting-point date for all fungi, coupled with adoption of a special status for the names used in the "basic books" of Persoon and Fries will yield an immense simplification of bibliographic work, will not cause the creation of fictitious new names, and will yield author citations that are far more consistent with existing literature.

We call upon the members of the IAPT's Special Committee for Fungi and Lichens to support the proposed changes in the Code suggested by the IMA's Nomenclature Committe, Subcommittee D: Starting Point Dates (van Warmelo, 1979), and specifically Principle II therein, Proposal (32).

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REVUE DES LIVRES

par

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COLLECTED MYCOLOGICAL PAPERS (RECUEIL DES ESSAIS MYCOLOGIQUES) par Narcisse-Théophile PATOUILLARD (1854-1926), édité par L. Vogelenzang, xxi + 2400 p., 110 pls., 3 vols. 8°, relié toilé, Septembre 1978. A. Asher & Co., Keizersgracht 526, Amsterdam 1002, Nederland. Prix Dfl. 975.-.

A. Asher & Co. a publié en 1963 l'*Essai taxonomique sur les familles et les genres des Hyménomycètes* de N. Patouillard (Lons-le-Saunier, Imp. Duclume, 1900, 184 p., ill.). Aujourdhui, il nous offre dans une fort belle édition la presque totalité du reste de l'oeuvre mycologique de Narcisse Patouillard, soit 263 publications parues de 1876 à 1928, y compris les travaux posthumes édités par R. Heim, et additionnées de la motice nécrologique de L. Mangin (1927). Ce recueil met ainsi à la disposition de tous l'oeuvre d'un grand mycologue français qui consacra sa vie à l'étude des Basidiomycètes. On se rapellera que ce fut Patouillard qui distingua au sein des Basidiomycètes les deux sous-classes *Hétérobasidiomycètes* et *Homobasidiomycètes*. Ses travaux multiples, réalisés au Laboratoire de Cryptogamie de Paris, sur les flores exotiques les plus diverses étendirent au monde la réputation qu'il avait acquise en son pays. Pour être complète, la réédition de l'oeuvre de Patouillard devrait encore comprendre ses deux séries illustrées et commentées d'exsiccata, *Les champignons figurés et désséchés*, par E. Doassans et N. Patouillard, vol. 1 (1880-1881) Exsiccata n° 1-44, vol.2 *Atlas* (1882-1883) 50 planches colorées, Paris, et les *Tabulae analyticae fungorum. Descriptions et analyses microscopiques des champignons nouveaux, rares ou critiques*, Fasc.1 à 7, Exsiccata n° 1-700, totalisant 338 p., 224 pls. Imp. Gindre, Poligny, (1883-1889), dont on aimerait voir réimprimées les étiquettes des exsiccata autant que les planches et le texte.

INTERESTING AND NEW SPECIES OF BASIDIOMYCETES FROM ECUADOR, par Rolf SINGER, Part I, réimpression du Supplément 51 de Nova Hedwigia 239-246, 1975, & II, réimpression de Nova Hedwigia, 29:1-98, 1977; 8°, broché, J. Cramer éd., 3301 Lehre, Deutschland. Prix DM 40.-.

Ces deux articles ont trait aux Basidiomycètes récoltés en Equateur par l'auteur (Partie 1) et par P.K. DUMONT et al. de New York (Partie 2). 123 espèces d'agaricales dont 3 nouvelles et 7 espèces d'aphyllophorales sont décrites et illustrées. On s'étonnera de voir la brochure s'ouvrir sur la 2e partie pour se terminer, après l'index, par la le partie.

BRITISH ASCOMYCETES, par R.W.G. DENNIS, 2e édition, xxiv+586 p.,31 pls. au trait, 44 pls. col., relié toilé, 1978. J. Cramer éd., poste 48, D-3301 Lehre, Deutschland. Prix DM 200.-.

Cette deuxième édition des *British Ascomycetes*, complètement revue et étendue, est en fait la troisième version de l'ouvrage d'abord intitulé *British Cup Fungi* (1960). Cette nouvelle édition comprend 876 espèces de 511 genres d'Ascomycètes, c'est-à-dire 84 espèces et 36 genres de plus que dans l'édition de 1968. Les commentaires taxonomiques et les références aux espèces voisines non encore observées dans les Iles Britanniques ont été largement amplifiées. L'illustration aussi a été modifiée. La planche en couleurs 12 est nouvelle; les planches en couleurs 1, 2, 7 et 8 remplacent les planches non colorées 3, 4 et 31 et la planche colorée 5 de l'édition de 1968. Les planches non colorées 6, 7, 12 et 31 sont nouvelles. Si l'auteur mérite toute la considération des mycologues pour cette mise à jour tant attendue d'un ouvrage déjà tant apprécié, il faut cependant regretter de graves imperfections de nature éditoriale. D'abord le texte revisé et amplifié sur les Acrospermataceae p.427 n'a pas donné lieu à la suppression de l'ancien texte sur *Acrospermum* p. 250. Une inversion de parties d'épreuves à la mise en page a fait apparaître les entrées de l'index *trichodea* à *undulata* aux pages 584-585 au lieu de la p. 583 entre *Trichobolus* et *unguicularia*. Et encore, le clichage offset, montre pour je ne sais quelle raison technique, un affaiblissement marqué, jusqu'à l'effacement, du texte à la partie gauche de très nombreuses pages, à tel point que de nombreux clichés durent être retracés à la main avant l'impression (quelques exemples: p.3ss, 130ss, 175ss, 201ss, 350ss, 416ss) pour les rendre lisibles. Enfin l'usage d'un papier épais et rude rend ce livre excessivement volumineux et d'une manipulation difficile et peu agréable, alors qu'il est destiné à se trouver dans les mains de tous les mycologues.

A SOURCE BOOK OF THE GENUS *PHYTOPHTHORA*, par Olaf K. RIBEIRO, xx + 417 p., ill., relié toilé, 1978, J. Cramer éd. FL 9490 Vaduz, Liechtenstein. Prix DM 80.-.

Cette compilation de toutes les informations disponibles sur les multiples aspects de l'étude des *Phytophthora* sera certainement bienvenue dans tous les laboratoires de phytopathologie autant que de mycologie. L'information, arrangée par rubrique, traite de la morphologie, des symptômes , de l'isolement et de la culture, de la sporulation sous toutes ses formes et de chaque espèce, de la survivance, de la pathogénécité, de la résistance de l'hôte, de la génétique, de l'écologie, de la cytologie, de la biochimie, du contrôle et enfin de la description et de l'identification des espèces. Les références bibliographiques sont dispersées dans le texte; les dessins des espèces sont de mauvaise qualité. Mais encore ce livre atteindra-t-il ceux à qui il est destiné, si son prix reste ce qu'il est. Si le texte avait été plus compact et la bibliographie réunie en une liste continue, près de 150 pages de papier blanc pouvaient être épargnées.

INDEX TO GENERA AND AUTHORS IN GREVILLEA, par Richard T. HANLIN. 167 p., 12°, broché, 1978, J. Cramer éd. FL 9490 Vaduz, Liechtenstein. Prix 40.-.

Il arrive fréquemment qu'un mycologue désireux de gagner du temps décide d'établir l'index alphabétique d'un livre ancien sans index qu'il consulte souvent. Plus rare est l'idée de le publier. Aussi faut-il féliciter l'auteur de ce travail, d'autant plus que *Grevillea* paru de 1872 à 1894 fut un journal très riche en nouveautés mycologiques. L'index des noms d'auteurs fait d'ailleurs apparaître de grands noms, tels que celui du fondateur M.C. Cooke, et ceux de Berkeley, Boudier, Crombie, de Bary, J.B. Ellis, E. Fries, Massee, Peck, Phillips, Flowright, Saccardo, Smith, Roumeguère et les Tulasne. R.T. Hanlin a aussi pris soin de rechercher la date précise de publication de chacun des 104 fascicules parus. Mais à nouveau, ce livre eut pu coûter la moitié de son prix, si la dactylographie du texte reproduit en offset avait été plus dense.

THE CLAVARIAS OF THE SIKKIM HYMALAYAS, par S.S. RATTA & I.P.S. KHURANA, 68 p., 89 figs., 12°, broché, 1978. J. Cramer éd., FL-9490 Vaduz, Liechtenstein. Prix DM 25.-.

The authors are of those Indian mycologists, under the direction of Dr K.S. Thind, devoted to the mycological flora of the Hymalayas. In this short paper , the authors report 30 species of Clavariaceae, including 1 new species and 2 new varieties. Descriptions and drawings are in the Corner's style. Probably aquarelles would have been in the same, if they had not been printed as worthless black and white photographs. It is certainly the freedom but also the responsability of both the authors and the editor to decide whether or not a paper as short as the present one has to be published in the shape of a book and at such a price. Should we suggest to J. Cramer taking advices from an editorial board?

LES FONDEMENTS DE LA TAXINOMIE DES RHODOPHYLLES ET LEUR CLASSIFICATION, par Henri ROMAGNESI, extrait de H. Romagnesi et G. Gilles *Les Rhodophylles des forêts côtières du Gabon et de la Côte d'Ivoire* (supplément 59 de Nova Hedwigia, p. 25-78 et 627-644, 1979) prépublié en 1978, paginé 1-80, 12° broché. J. Cramer éd. FL 9490 Vaduz, Liechtenstein. Prix DM 19,80 !

Ce tirage-à-part, prébublié sous un titre différent, est extrait d'un livre paru en 1979. H. Romagnesi le destine "aux mycologues qui ne seraient pas spécialement intéressés par la mycoflore de ces régions, mais qui désirent connaître d'une façon générale, les conséquences de cette étude sur la taxinomie et la classification de ce genre difficile". C'est en fait une forme de plaidoyer insistant en faveur de l'usage de caractères microscopiques tels que la forme des spores, la présence de granules lipidiques et la localisation des pigments et aussi en faveur d'une typification prudente des vieux genres friesiens. Malheureusement le style en est trop celui du réquisitoire contre "l'ostracisme" des mycologues moins convaincus et la "vésanie" d'autres, "certes très éminents" qui, appliquant "les dispositions de notre malheureux Code de nomenclature avec rigidité", conduisent la taxonomie "des pauvres Rhodophylles" à "ce calice amer" qu'est "trois fois hélas! la systématique dite moderne des Polypores et des Corticiés" (p. 7, 25,31).

BASIDIOMYCETES THAT DECAY ASPEN IN NORTH AMERICA, par J. Page LINDSEY et Robert L. GILBERTSON, 406 p., 260 figs., 12 pls. phot. b.n., 8°, relié toilé, 1978, J. Cramer éd., FL-9490 Vaduz, Liechtenstein. Prix DM 120.-.

Avec un autre livre de Gilbertson *The fungi that decay ponderosa pine*, cet ouvrage sur les champignons nuisibles au peuplier constitue un ensemble couvrant la plupart des champignons lignivores d'Amérique du Nord, et de cette manière apporte une base solide à une pathologie des arbres et du bois. 395 pages d'un texte dense mais bien lisible, où les auteurs décrivent et illustrent excellemment260 espèces et fournissent pour chaque genre des clés d'identification et pour chaque espèce les caractères microscopiques nécessaires. Une série de photographies, en particulier d'excellentes vues de détail au SEM, donne une touche vivante à la technicité du contenu. Un glossaire terminologique donne la signification de termes parfois inhabituels. L'index, comme malheureusement beaucoup d'index publiés, subordonne les épithètes spécifiques aux noms de genres de telle sorte qu'il est impossible de retrouver une espèce selon l'ordre alphabétique. Par le grand nombre d'espèces dont 224 sont des Aphyllophorales et dont la distribution est souvent cosmopolite, ce livre doit avoir une très large audience et la mérite.

MYCOLOGIE ET PATHOLOGIE FORESTIERES. I.MYCOLOGIE FORESTIERE, par L. LANIER, P. JOLY, P. BONDOUX et A. BELLEMERE, xiv +487 p., nbr. figs., 8°, relié toilé, 1978, Masson éd., 120 Bd. St-Germain, F-75280 Paris . Prix non donné.

Il est peu de pays où les ingénieurs et phytopathologues forestiers disposent d'un traité moderne de pathologie forestière. Cet ouvrage tant attendu est le fait de quatre spécialistes de langue française, un forestier, un phytopathologue et deux mycologues. Fruit d'une harmonieuse concertation des auteurs, cet ouvrage est scientifique, précis, moderne, didactique, parfaitement équilibré et témoigne de la compétence de ses auteurs. Le second volume déjà paru (Mycotaxon 7:523, 1978) traite de la *Pathologie forestière*, le présent volume de *Mycologie forestière*. Une introduction de 70 p. par A. Bellemère et P. Joly montre les multiples aspects de la vie des champignons et de leur structure. Le reste du volume est consacré aux clés d'identification des espèces significatives de chaque classe, famille et genre. Quelques 3500 espèces fongiques, par ailleurs reprises à l'index, sont citées, décrites, illustrées, ou commentées dans leurs caractères microscopiques ou leur rôle forestier. Les clés par P. Joly (Basidiomycètes) et par A. Bellemère (Ascomycètes) sont remarquables et dénotent de vues d'avant-garde sur certains groupes (Discomycètes). Les illustrations très nombreuses sont de grande précision. Ce livre est destiné à quiconque s'occupe de pathologie et mycologie des arbres et du bois. Son usage dans l'enseignement universitaire favorisera le développement de la pathologie forestière, discipline trop peu affirmée à ce jour. A ce niveau, une édition en langue anglaise lui assurerait une très large diffusion.

BOTRYOTINIA AND *BOTRYTIS* SPECIES: TAXONOMY, PHYSIOLOGY AND PATHOGENECITY. A GUIDE TO THE LITERATURE. par W.R. JARVIS, 195 p., 8°, broché, 1977. Canada Department of Agriculture, Information Div., Ottawa K1A 0C7, Canada. Prix non indiqué.

Un guide dans la littérature abondante sur *Botryotinia* et *Botrytis* sous tous les aspects de la taxonomie à la lutte, en passant par l'écologie, la biologie et la pathogénie, l'auteur l'a fort bien réussi, par une sélection judicieuse de 960 références bibliographiques et l'intégration de l'information dans un texte analytique et détaillé. Ce livre est dorénavant l'outil de travail de tous ceux qui étudient ces champignons et leur biologie.

ATLAS DE MICOLOGIA BASICA, par M. ULLOA et R. HANLIN, xxix + 158 p., 37 pls. b.n. (dessins et 233 phot.), 1978, Editorial Concepto, Av. Cuauhtémoc 1434, México 13, D.F. Prix non donné.

Cet *Atlas* est en fait un manuel fort bien illustré de mycologie générale. Le texte expose d'abord la classification des champignons, ensuite leur croissance en milieu naturel et in vitro et enfin un commentaire morphologique, biologique et écologique sur chaque genre et leurs principales espèces. L'illustration abondante est composée d'une part de 233 excellentes microphotographies et d'autre part de dessins en demi-ton à la "Tulasne".Elle est l'oeuvre de M. Ulloa. Illustrant plus de 100 espèces, elle les montre dans leurs traits les plus significatifs pour un exposé didactique de la mycologie. Sans doute le texte gagnerait à s'enrichir d'informations à mon avis importantes. Si l'action hallucinogène de plusieurs espèces de *Psilocybe* mérite d'être mentionnée,la pathogénie d'*Armillaria mellea* ne peut être passée sous silence. Si ce livre doit servir à l'enseignement, maîtres et étudiants se plaindront du mauvais encollage du dos qui se brise à la première ouverture, par suite de l'utilisation d'une résine friable au lieu d'une colle flexible à base de latex acrylique.

FUNGUS-HOST INDEX FOR GREECE par Maria E. PANTIDOU,382 p., broché, 1973, Benaki Phytopathological Institute, Kiphissia, Athens. Prix $ 10.50 poste incluse.

Cet index des champignons de Grèce et de leurs hôtes couvre plus de 2000 espèces de champignons et 1200 plantes-hôtes. Cette liste à laquelle l'auteur a mis tout le soin nécessaire se base sur le dépouillement de 129 publications mycologiques et phytopathologiques ainsi que sur les relevés des espèces préservées dans les collections de l'Institut phytopathologique Benaki. Cet index sera fort utile à tout mycologue et phytopathologue intéressé à ces régions.

A COMPENDIUM OF ALFALFA DISEASES, par J.H. GRAHAM, D.L. STUTEVILLE F.I. FROSHEISER et D.C. ERWIN, 80 p., 70 figs.b.n. & col., 4°, broché, juin 1978, The American Phytopathological Society, 3340 Pilot Knob Rd., St Paul, Minnesota 55121. Prix $ 7.-.

La première partie concerne les maladies abiotiques de l'Alfafa, *Medicago sativa*, la seconde partie les maladies biotiques, bactériennes, fongiques et autres. 24 maladies d'origine fongique sont décrites et illustrées. L'agent causal, les symptômes, les moyens de lutte sont précisés et soutenus par des références bibliographiques. L'illustration est de très bonne qualité, et pour la moitié en couleurs. Une clé d'identification des maladies sur la base des symptômes est aussi donnée. Toute la précision nécessaire est mise dans la description des champignons pathogènes; la nomenclature, elle, est a peu près correcte, '*Phymatotrichum*' restant encore d'usage là où devrait l'être *Phymatotrichopsis*.

ANNUAL REVIEW OF PHYTOPATHOLOGY, vol. 16, par R.G. GROGAN, G.A. ZETMYER, E.B. COWLING, éd., 528 p., 8°, relié toilé, 1978. Annual Reviews Inc. 4139 El Carmino Way, Palo Alto, Ca 94306. Price $ 17.

Bien qu' aucun article ne relève de mycologie systématique, on retiendra les progrès de la recherche mycologique et phytopathologique au Brésil (A.A. Bitancourt), une rétrospective sur l'oeuvre de J.C. Arthur (G.B. Cummins) et Julius Kuehn, la culture axénique de nématode pour l' amateur de 'nématode-traping fungi' (J. Vanfleteren), une revue biologique de '*Phymatotrichum omnivorum*' (aujourdhui *Phymatotrichopsis omnivora*) (S.D. Lyda), les facteurs de sporulation des champignons parasites in vivo (J. Rotem), enfin la génétique de la symbiose et des relations interorganismes (W. Loegering).

ASCOMYCETES OF PAKISTAN, PART I, par Sultan AHMAD, Biological Society of Pakistan, Monograph n° 7, viii + 236 p., ill., 8°, agrafé, 1978, Biological Society of Pakistan, The Biological Laboratories, Government College, Lahore, Pakistan, imprimé par l'auteur.

"This publication, it is hoped, will provide an impetus to the student to work hard and bridge the existing gaps in our knowledge of this group of fungi" (p.v). Ainsi s'exprime l'auteur après 30 années d'étude de la mycoflore du Pakistan. 472 espèces d'Ascomycètes, dont 3 nouvelles, sont réunies dans ce volume de synthèse, décrites et illustrées selon une taxonomie et une nomenclature modernes. La bibliographie fait référence à des travaux de l'auteur des années 1946, 1955, 1968, 1970, 1971. Infatigable, l'auteur nous présente ce volume comme une première partie de la flore des Ascomycètes du Pakistan et implicitement nous promet une suite. Nous ne pouvons que l'encourager à poursuivre avec de nombreux disciples une oeuvre si bien commencée.

THE DIAPORTHALES IN NORTH AMERICA WITH EMPHASIS ON *GNOMONIA* AND ITS SEGREGATES, par Margaret E. BARR, Mycologia Memoir n° 7, 232 p. 132 figs., 8°, relié toilé, 1978, J. Cramer éd., p.o.b.48, D-3306 Lehre, Deutschland. Prix DM 80.- ($ 20.- for A.M.S. members).

Ce cinquième mémoire du *New York Botanical Garden* et de la *Mycological Society of America* est une importante addition au florilège mycologique de l'Amérique du Nord. L'auteur qui depuis longtemps fait autorité dans ce groupe de champignons Ascomycètes, présente ici, sur la base de son expérience sur le genre *Gnomonia*, un essai taxonomique des genres de Diaporthales connus en Amérique du Nord. Après un court aperçu historique, l'auteur introduit son concept de l'ordre et les caractères diagnostiques majeurs au niveau du genre, les tissus stromatiques de la fructification, la position de celle-ci sur l'hôte et les forme et dimensions des ascospores. Elle reconnaît 2 sous-ordres, les *Gnomoniineae* et les *Melanconidineae*. 53 genres sont recencés, 51 redéfinis et 2 décrits comme nouveaux, *Apioplagiostoma* et *Chapeckia*. Quelques 200 espèces sont décrites illustrées et commentées, 35 de celles-là dans le genre *Gnomonia*; quelques espèces extra-américaines sont incluses et revisées;6 espèces et 9 variétés sont nouvelles. Un index des noms et épithètes, un index des hôtes et une liste commentée des taxa rejetés terminent l'ouvrage. Qui n'a déjà ce Mémoire se doit de le connaître.

MOOSBEWOHNENDE ASCOMYCETEN I. DIE PYRENOCARPEN, DEN GAMETOPHYTEN BESIEDELNDEN ARTEN, by P. DÖBBELER, Mitteilungen der Botanischen Staatssammlung, München, Bd. 14, 360 p., 64 figs., 12°, paperback, 1 june 1978, Botanische Staatssammlung München, Menzinger strasse 67, D-8000 München 19, Deutschland. Prix non indiqué.

This study, printed from a very well shaped manuscript ready copy, deals with the Pyrenoascomycetes which occur on the gametophytes of mosses. Out of the 123 know taxa pertaining to 33 genera, the author has been able to record 89 species in 21 genera from Europe and other countries through the world.In addition, 9 genera, 62 species and 3 varieties are described as new.Also, necessary redispositions and synonymies have been made. It is significant that most of the studied taxa belong to the Dothideales, a few only to the Hypocreaceae and the Lasiosphaericeae.Amongst the latter the genera *Lasiosphaeria, Leptoneliola, Pleosphaeria, Pleospora, Teichospora* have been intentionally omited. The literature on all taxa was thoroughly surveyed. These fungi appeared very common and restricted to their host (over 250 species) and might have evoluted independently. This important piece of work is the doctoral thesis of its author.

LOWER FUNGI IN THE LABORATORY, par Melvin S. FULLER, ix + 123 p. 92 pls phot. b.n., 2 portraits, 4°, broché, 1978, Department of Botany, University of Georgia, Athens, Georgia 30602, USA. Palfrey Contributions in Botany n° 1. Prix $ 11.-.

Ce très bel album est un hommage à Ralph EMERSON offert par 60 mycologues qui ont bénéficié de son enseignement et de ses connaissances des Champignons Inférieurs et par la *Mycological Society of America.* Tout l'esprit, la méthode et l'enthousiasme du Maître (Mr Water Mold pour les intimes) transparaissent dans ces 120 démonstrations mycologiques sur les *Water Molds*. La bonne centaine d'espèce traitées appartiennent aux Chytridiomycètes, Hyphochytridiomycètes, Oomycètes, Zygomycètes Trichomycètes, Plasmodiophoromycètes et Labyrinthulomycètes. Ces exercices sont tous illustrés d'une iconographie photographique en pleine page assortis d'un texte variablement documenté. Un complément de notes méthodologiques sur la culture, la coloration, la préservation, l'observation au microscope électronique, etc, complète ce guide. Assempblé par la reproduction de'manuscript ready copies', l'ouvrage montre une certaine hétérogénéité dans la présentation des démonstrations, bien qu'elles suivent pour la plupart un modèle préparé par R. Emerson. Ce modèle est construit pour fournir un calendrier des observations à effectuer, mais n'est pas compréhensible sans se référer à un article d'Emerson dans Mycologia 50:589, 1958. Ces données indispensables devaient être reprises. Les illustrations, par contre, témoignent bien d'une générale fidélité au style de haute qualité toujours pratiqué par R. Emerson. De toute évidence, ce livre s'impose dans toute bibliothèque mycologique, dans tout laboratoire de mycologie, fût-ce comme exemple, et par dessus tout dans l'enseignement des *Lower Fungi.*

MANUEL DE MICROSCOPIE, par Marcel LOCQUIN et Maurice LANGERON, xxii + 352 p., 152 figs., 8° relié toilé, 1978, Masson & Co éd., 120 Bd St-Germain, F-75280 Paris 6, France. Prix non indiqué.

Depuis longtemps annoncé par son premier auteur, cet ouvrage est enfin paru, et, nous le croyons, à la satisfaction de tous. M. Locquin considérant son ouvrage comme une continuation du *Précis de Microscopie* de Maurice Langeron (Masson, 1942), s'est associé le nom de son ancien maître. L'ouvrage se divise en 6 chapitres. Le premier chapitre des principes directeurs de l'instrumentation et des techniques instrumentales de microscopie (microscopie photonique, interférentielle, la microphotographie, la stéréométrie, jusqu'à la microanalyse électronique). Le second chapitre détaille les méthodes préparatives de fixation, de coupe, de montage et d'examen. Les chapitres suivants donnent une liste de près de 2000 colorants, avec formule, synonymie et usage. Les derniers chapitres étudient les méthodes de coloration et d'imprégnation, les techniques propres à l'histologie animale et végétale, à la protistologie et à la mycologie. Une abondante information sur les constantes physicochimiques utiles en microscopie, un glossaire trilingue, en annexe, une bibliographie récente et un index général terminent l'ouvrage. Quel mycologue n'est pas à la recherche d'une technique plus appropriée à un probème particulier? A côté du *Mycological Guidebook* (New York, 1971), ce livre lui apportera des informations utiles.

BIOLOGICAL TRANSFORMATION OF WOOD BY MICROORGANISMS, Proceedings of the Sessions on Wood Products Pathology at the 2nd International Congress of Plant Pathology, September 10-12, 1973, Minneapolis, par Walter LIESE, éd., 203 p., ill., 8° broché, 1975. Springer Verlag, Berlin. Prix non indiqué.

Les communications présentées ont surtout porté sur la colonisation du bois par les champignons et les bactéries et les interactions entre les organismes, ensuite sur la micromorphologie du bois attaqué en relation avec la résistance naturelle ou acquise du bois et enfin sur les mécanismes enzymatiques de la dégradation de la cellulose, de la lignine et de la chitine par diverses espèces de champignons.

THE CORTICIACEAE OF NORTH EUROPE, VOL. 5 *MYCOACIELLA-PHANEROCHAETE*, par John ERIKSSON, Kurt HJORTSTAM et Leif RYVARDEN, pp. 885-1048, figs. 447-534, 8°, broché, 1978, Ed. Fungiflora, p.o.b. 95, Blindern, Oslo 3, Suède. Prix N.Kr. 80.-.

Ce volume 5 des "Corticiacées du Nord de l'Europe" est le bienvenu, après la publication tant appréciée des volumes 2, 3 et 4. (voir Mycotaxon 4:324, 1976; 5:364, 1975). Ce volume traite des genres suivants: *Amylostereum, Ceraceomyces, Hydrabasidium* (en addition), *Mycoaciella, Odonticium, Oliveonia, Paullicorticium, Peniophora, Phanerochaete*. Une nouvelle espèce et 10 nouvelles combinaisons sont proposées. Les auteurs maintiennent la qualité des descriptions et des illustrations. Les dessins de J. Eriksson sont caractéristiques. Cependant, contrairement aux volumes précédents et par suite de l'impression sur un papier non glacé, l'impression des photographies en blanc-noir a perdu beaucoup de la qualité présumée des originaux. Nous espérons que l'éditeur y paliera dans les prochains volumes. Le présent volume et les précédents susciteront certainement un renouveau d'intérêt pour ce groupe bien difficile de Basidiomycètes.

RUST FUNGI ON LEGUMES AND COMPOSITES IN NORTH AMERICA, par George B. CUMMINS, xii + 424 p., 355 figs., 8° broché, 1978, University of Arizona Press, Box 3398, Tucson, Arizona 85722, USA. Prix $ 9.-

L'auteur, expert bien connu des rouilles d'Amérique du Nord, apporte par ce livre une pièce de plus à l'édifice de la flore des Urédinales du continent américain. 355 espèces appartenant à 32 genres y sont méthodiquement décrites et figurées, relevées à elles seules sur les légumineuses et les composées. Les *Puccinia* sont représentés par 150 espèces, les *Uromyces* par 55. Bon nombre des espèces sont recensées également en Amérique centrale et en Amérique Latine. Un certain nombre sont aussi européennes. Edité à très bas prix, ce livre connaîtra une large diffusion.

1.ON CERTAIN SPECIES OF *MUCOR* WITH A KEY TO ALL ACCEPTED SPECIES.
2. ON THE GENERA *RHIZOMUCOR* AND *PARASITELLA*. par M.A.A. SCHIPPER, Studies in Mycology n° 17, 71 p., 34 figs., 8°, broché, 29.12.1978, Centraalbureau voor Schimmelcultures, Baarn, Nederland. Prix Hfl.20.

La revision des 23 dernières espèces de *Mucor* et les résultats de leur confrontation sexuelle termine la revision des espèces de *Mucor* disponibles en culture (voir Studies in Mycology 4(1973), 10(1975) et 12 (1976)). Une clé dichotomique d'identification est proposée pour l'ensemde ces 39 espèces, 2 variétés et 8 formes. Une clé synoptique n'eut-elle pas été préférable? L'auteur réhabilite aussi le genre *Rhizomucor* pour trois espèces thermophiles, *Rhizomucor pusillus, R. miehe* et *R. tauricus*. Les genres voisins *Backusella* et *Parasitella* sont maintenus distincts.

A COMPILATION OF THE *ASPERGILLI* DESCRIBED SINCE 1965, par Robert K. SAMSON, Studies in Mycology n° 18, 38 p., 7 figs., 8°, broché, 30.1.1979, Centraalbureau voor Schimmelcultures, Baarn, Nederland. Prix Hfl. 10.-.

Il est souvent difficile, après la publication d'une monographie, de suivre la publication des espèces nouvelles qu'elle a pu susciter. Ainsi depuis la publication de *The genus Aspergillus* de Raper et Fennell en 1965, 89 taxa nouveaux ont été publiés. Samson les a revus. Il en accepte 34 et rejette les autres pour des raisons qu'il explicite. De plus il reconsidère le statut des 9 genres téléomorphiques dont les anamorphes sont des *Aspergillus* et les redécrit brièvement, *Chaetosartorya, Dichlaena, Emericella, Eurotium, Fennellia, Hemicarpenteles, Neosartorya, Petromyces et Warcupiella.*

FUNGORUM RARIORUM ICONES COLORATAE VII, par Meinhard MOSER, 48 p., 8 pls. col. 95 figs., 8°, 1978, J.Cramer, FL-9490 Vaduz. Prix DM 35.

Ce fascicule contient les descriptions et aquarelles de 25 espèces des genres *Hygrophorus, Tricholoma, Porpoloma, Mycena, Pholiota, Stropharia, Conocybe, Pachylepirium, Bolbitius, Melanotus, Agrocybe, Simocybe, Naucoria, Xerampelina, Lactorius* et *Inocybe.*

FUNGORUM RARIORUM ICONES COLORATAE IX, par Aurel DERMEK, 32 p., 8 pls. col., 18 figs., 8°, 1979. J. Cramer, FL-9490 Vaduz. DM 35.-.

Ce fascicule contient les descriptions et aquarelles de 18 taxa de Boletaceae dans les genres *Boletus, Boletinus, Xerocomus, Buchwaldoboletus* et *Leccinum.*

FUNGORUM RARIORUM ICONES COLORATAE X, par Solomon P. WASSER, 32 p., 8 pls. col., 6 figs., 8°, 1979, J. Cramer, FL-9490 Vaduz. DM 35.-

Ce fascicule contient les descriptions et aquarelles de 14 taxa dans les genres *Agaricus, Cystoderma, Leucocoprinus, Leucoagaricus* et *Galeopsis.*

FUNGORUM RARIORUM ICONES COLORATAE XI, par Marcel BON, 40 p., 8 pls. col., 6 figs., 8°, 1979, J. Cramer, FL-9490 Vaduz. DM 35.-.

Ce fascicule contient les descriptions et aquarelles de 17 taxa des genres *Hygrocybe, Lactarius, Russula, Calocybe, Hebeloma, Inocybe, Leucoagaricus, Lepiota* et *Amanitopsis.*

LES RHODOPHYLLES DES FORETS COTIERES DU GABON ET DE LA COTE D'IVOIRE par Henri ROMAGNESI et Gérard GILLES, Beihefte zur Nova Hedwigia 59, 649 p., 290 figs., 8°, relié toilé, 1979, J. Cramer, FL-9490 Vaduz, DM 200.-/250.-

Dix années de récoltes et d'annotations sur le vivant par Gerard Gilles au Gabon et en Côte d'Ivoire et dix années d'études microscopiques par H. Romagnesi ont été nécessaires pour mettre au point cette série de 184 espèces et variétés nouvelles de Rhodophylles d'Afrique.

Dans l'introduction, d'ailleurs déjà prébubliée par H. Romagnesi chez J. Cramer en 1978 et recensée dans ces pages, H. Romagnesi précise les caractères diagnostiques principaux: la forme géométrique des spores, la fréquence des boucles, les granules lipidiques de la trame, les accumulations de pigments et la texture de la cuticule. Dans la même introduction, H. Romagnesi n'apprécie pas l'application stricte des règles de la Nomenclature botanique bien qu'elle seule garantisse l'univocité du langage botanique. En effet la question est la suivante: *Entoloma* Fr.1836 ou *Rhodophyllus* Quélet 1886? H. Romagnesi a choisi *Rhodophyllus* Quelet. La contribution que lui-même et Gérard Gilles apportent à ce genre l'amplifie à 1318 espèces et variétés qu'ils acceptent et dont ils donnent une liste en fin de l'ouvrage. Aussi espérons-nous que soit un jour élaborée une clé synoptique de cet ensemble mycologique aussi attrayant que touffu.

KARSCHIA, REVISION EINER SAMMELGATTUNG AN DER GRENZE VON LICHENISIERTEN UND NICHTLICHENISIERTEN ASCOMYCETEN, par J. HAFELLNER, Beihefte zur Nova Hedwigia 62, 248 p., 46 figs., 8°, relié, 1979, J. Cramer, FL-9490 Vaduz, Liechtenstein. Prix 96.-/120.-.

Les unes libres, les autres lichénisées, 68 espèces de champignons jusqu'à ce jour classées dans le genre *Karschia*, sont ici revues et reclassées par l'auteur dans pas moins de 19 genres différents, les uns des Lecanorales, les autres des Dothidéales: chez les Lecanorales, *Buellia* (12 sp.), *Epilichen* (2), *Rhizocarpon* (3), *Rinodina* (1), *Dactylospora* (27), dont 9 espèces et variétés nouvelles, et chez les Dothidéales, *Buelliella* gen. nov. (3), *Cycloschizon* (1), *Colensoniella* gen. nov. (1), *Dothidea* (1), *Eutryblidiella* (2), *Gibbera* (1), *Heteresphaeriopsis* gen. nov. (1), *Karschia* (2), *Poetschia* (4), *Pseudodiscus* (1), *Rhizodiscina* gen. nov. (1), *Rhizogene* gen. nov. (1) et *Schrakia* gen. nov. (2), dont 3 espèce et variétés nouvelles. La taxonomie de l'auteur se fonde principalement sur la structure apicale de l'asque et la structure ontogénique de l'ascocarpe, en plus de les caractéristiques sporales et de la réaction à l'iode. Cette monographie d'un groupe inexploré, soignée dans son élaboration et dans son édition, est un exemple propre à susciter d'autres recherches.

ASCOMYCETEN AUF ERICACEEN IN DEN OSTALPEN, par Paula REMLER, in Bibliotheca mycologica n° 68, 322 p., 18 figs., 1 carte, 8°, relié 1979, J. Cramer, FL-9490 Vaduz. Prix DM 64.-/80.-

L'analyse mycologique d'un site écologique défini, qu'il soit géographique, microclimatique ou botanique, tel une plante-hôte, est une méthode conseillée d'une recherche à la fois limitée et féconde. Paula Remler qui a limité sa recherche aux Ericacées de la végétation alpine, y a relevé 94 espèces d'Ascomycètes dont 45 Discoascomycètes sur 13 espèces-hôtes. Les espèces de *Rhododendron*, en particulier *R. ferrugineum*, et de *Vaccinium*, en particulier *V. myrtillus*, sont les plus richement colonisées. 9 espèces nouvelles sont décrites. Si les résultats de ces 4 ans de recherche sont intéressants, leur présentation laisse à désirer. La dactylographie de la matrice eut beaucoup gagné à être plus compacte et dès lors moins longue et plus économique. Une clé dichotomique de 31 pages pour l'identification d'espèces très diversifiées d'une microflore tout de même encore incomplète et locale n'a que peu d'intérêt. Elle eut pu laisser la place à un dessin de chaque espèce décrite. L'ouvrage eut été alors d'un plus grand intérêt.

AUSTROBOLETUS AND *TYLOPILUS* SUBGENUS *PORPHYRELLUS* WITH EMPHASIS ON NORTH AMERICAN TAXA, by Carl B. WOLFE, Bibliotheca Mycologica 69, 148 p., 65 figs., 5 pls. phot. b.w., 8°, bound, 1979, J. Cramer, FL-9490 Vaduz.Price DM 32.-/40.-.

Porphyrellus Gilbert (type: *Boletus porphyrosporus Fr.*) is considered by Singer a genus related to *Strobilomyces* and segregated from *Tylopilus*. In *Porphyrellus*, Singer recognizes two sections, sect. *Porphyrellus* and sect. *Graciles*. Wolfe considers *Porphyrellus* sect. *Porphyrellus* more closely related to *Tylopilus* and agrees on the subgenus *Tylopilus* subg. *Porphyrellus* (Gilbert)Smith & Thiers.Regarding *Porphyrellus* sect. *Graciles* sufficiently distinct from *Tylopilus*, he elevates its synonymous subgeneric name to generic rank as *Austroboletus* (Corner) Wolfe. The author justifies his taxonomical treatment, but confusedly. Macroscopic and microscopic characters are given to both circumscriptions. *Tylopilus* sect. *Porphyrellus* is divided in 2 sections and accomodates 9 species. *Austroboletus* also has 2 sections but for 3 species. A key to world taxa is provided but with abreviated generic names and without explanations.In a separate chapter, the type materials are fully described and illustrated, even those of the species accepted and redescribed in the author's treatment.The illustrations are confusedly numbered. Line drawings are in the text and numbered 1 to 15 and 38 to 65. Figs. 16-37 are SEM photographs nicely assembled in three plates 'hors texte' but not referred as plates, and together with five photographs of pilei disposed in three full pages (really plates) but each of them being referred to as plate instead of figure and numbered 1-5.

The GASTEROMYCETES OF AUSTRALIA AND NEW ZEALAND, par G.H. CUNNINGHAM, Bibliotheca Mycologica 67, 236 p., 37 pls. 1942, John Mc Indoe, Dunedin, N.Z., réimpression 1979, relié, J. Cramer, FL-9490 Vaduz. Prix 64.-/80.-.

Ce livre de 1942 s'est avéré une pièce maitresse de la flore mycologique d'Australie et de Nouvelle Zélande. Résultat d'un labeur de 20 années et de l'examen de plus de 10000 specimens, ce livre garde sa valeur taxonomique bien la nomenclature et l'information soient dépassées. Cette réimpression, d'ailleurs bien faite, est bienvenue.

DIE PHYTOPATHOGENEN GROSSPILZE DEUTSCHLANDS, BASIDOMYCETES MIT AUSSCHLUSS DER ROST- UND BRANDPILZE, by Hanns KREISEL, 284 p., 45 figs., 65 pls. phot. b.w.(figs. 46-111), 8°,Gustav Fischer, Reprint 1979, bound, J. Cramer, FL-9490 Vaduz.

The scope of this book might have surprised, but it originated in the lack of updated identification keys to tree pathogenic fungi since the handbooks of Sorauer (1886-1908) and of Neger (1924). Restricted to the tree attacking and wood destroying Basidiomycetes, the book o-fers good identification keys and specific details about the biological behaviour of the selected species. It also includes 65 goods black and white photographs of fungi. The reprint is of good quality.

TABULAR KEY TO THE SPECIES OF *PHYTOPHTHORA* DE BARY, by F.J. NEWHOOK, G.M. WATERHOUSE and D.J. STAMPS, *Mycological Papers 143*, 20 p., 3 tabl., 4 pls. (55 figs.), 31.12.1978, Commonwealth Mycological Institute, Kew, England.

Synoptic keys for the identification of fungi are of easier use than dichotomic keys. Synoptic keys can have the shape of a table, like that one proposed by the authors for the species of *Phytophthora*. Such table has two entries, one to the taxa, the other to the characters. Another shape of the synoptic key is the one used by Korf (Mycologia, 64:937, 1972), which consists in the listing of the species reference numbers with each of the characters observed. The table might be large and their printing difficult; the numerical listing can hold in usual justification, but is of slower use. It should be noticed that the synoptic key table proposed for *Phytophthora* is assorted with a number of excellent photographs.

STUDIES ON *CERCOSPORA* AND ALLIED GENERA. VII NEW SPECIES AND REDISPOSITIONS, par F.C. DEIGHTON, *Mycological Papers 144*, 55 p. 28 figs., 8°, 1.8.1979, Commonwealth Mycological Institute, Kew.

Dr Deighton is wel known for his *Studies on Cercospora and allied genera*. With this VIIth part,he proposes 8 new species and 22 new combinations in *Pseudocercospora, Paracercospora* a new genus, *Mycovellosiella, Phaeoramularia, Stenella* and *Cladosporium*. The author claims that these genera can be recognized on the natural substratum and find himself in divergence with Ellis about some of their characters. Von Arx considers the four latter genera synonymous. A synoptic keys to all the genera of the group might be suggested.

GRAMINICOLOUS *ASCOCHYTA* SPECIES, by E. PUNITHALINGAM, *Mycological Papers 142*, 214 p., 108 figs., 17 pls. phot., 8°, 1.6.1979, Commonwealth Mycological Institute, Kew.

To enlight the taxonomy of an as large genus as *Ascochyta* is one of the most difficult task in the Sphaeropsidales. Restricting his task to the graminicolous species, the author segregated from allied genera 150 species of *Ascochyta* , of which he accepted 49 taxa only and added 28 new ones. Two new telemorphic species *Didymella phleina* and *Didymosphaeria loliina* are described with an *Ascochyta* anamorph. The diagnosis of the species is based on morphological features only and not host specificity, what is a real progress in the study of the genus. The conidiogenesis is also emphasised. At first purely holoblastic, the conidia are produced enteroblastically at an older stage only. Most of the species described are illustrated with line drawings and photographs.

PATTERNS OF DEVELOPMENT IN CONIDIAL FUNGI, par Garry T. COLE et Robert A. SAMSON, 190 p., 99 figs., 4°, relié, 5 juin 1979, Pitman Publishing Ltd, 39 Parker street, London WC2B 5PB, 6 Davis Drive, Belmont, California 94002.Prix £29.75.

Après les travaux de Vuillemin et de Mason et le très fameux article de Stanley J. Hughes *Conidiophores, conidia and classification* (Can. J. Bot. 1958), une révolution s'est opérée dans l'étude et la taxonomie des Hyphomycètes, qui s'étendit bientôt à l'ensemble des Deuteromycètes. Les caractères trop superficiels et changeants utilisés encore par Saccardo ont fait une plus large place aux caractères ontogéniques plus stables. A l'ancienne taxonomie s'est substituée une nouvelle Taxonomie. Les auteurs se sont succédés: Tubaki, Barron, Subramanian, Madelin, et d'autres. Ils ont tenté d'affiner. Un symposium s'est réuni: Kananaskis I, et ses actes *Taxonomy of Fungi Imperfecti*, édités par Kendrick (1971) ont

marqué : une nouvelle étape : la microphotocinématographie discontinue au microscope optique. Aujourdhui, un autre sommet est atteint dans l'escalade: c'est le *Patterns of Development in Conidial Fungi* de Garry Cole et de Robert Samson. Le voile est levé, cette fois. Et on peut s'exclamer avec Harold Brodie "*Fungi: Delight of Curiosity!*" devant ces réels bourgeonnements du *Candida albicans* que l'on découvre à la première page du livre. Fiction? non, réalités micrométriques que le microscope électronique met à la portée du champ de notre vision. Le livre est un album d'images, il se veut agréable, même beau: c'est la nature qui est belle. La conidie nait, se tient en équilibre, vacille et tombe, une déchirure s'est produite. L'hélicoïde s'enroule, l'épi progresse, la grappe se déploie, la phialide éjecte sa derniere née et le filament s'allonge pour se briser en articles. Ainsi naissent et se succèdent les conidies des champignons conidiens. Ce que le mycologue depuis plus de vingt ans contemple à l'oculaire de son microscope, Cole et Samson nous le font voir. Mais au delà de cette imagerie, de la conidiogénèse, les auteurs en reprennentles principes, analysent les cas, soulèvent les inconnues. Deux types fondamentaux de conidiation, le type blastique et le type arthrique, chacun pouvant être holopariétal ou entéropariétal, donnent, suivant le nombre de conidies formées, leur ordre et leur position relatives, une surprennante diversité de types (*Patterns*) conidiogénétiques. Ainsi après Kendrick, Cole et Samson ont prouvé au yeux de tous l'existence de ce qu'avaient *vu* Vuillemin, Mason et Hughes. L'ouvrage est édité avec grand soin et esthétique. Non seulement il sera le compagnon de beaucoup de mycologues, et de biologistes, mais aussi un émerveillement pour le profane.

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THE FRUITING AND DEVELOPMENT OF *RHODOTUS PALMATUS* IN CULTURE

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SUMMARY

Rhodotus palmatus (Bull. ex Fr.) R. Maire was fruited in culture and the phenotypic responses of the fruiting body to varying light conditions studied. Fruiting occurs in green, yellow or red light above 500 nm but only in the absence of blue light below 500 nm. However, pileus pigment color and size as well as stipe length and size are altered by the light quality and percent transmission through the test filters. A very plastic species, such as this, also exhibits a broad phenotypic response in nature to the changes in light quality and other abiotic factors. The implications of properly evaluating phenotypic variation in systematic mycology are discussed.

INTRODUCTION

Rhodotus palmatus (Bull. ex Fr.) R. Maire is known to occur in Europe, North Africa and in eastern North America.

It is a pleurotoid agaric with creamy pink spores. It grows commonly on the limbs and branches of hardwoods, differs sharply from other agarics by possession of an unusual reticulate ridged cap cuticle, tuberculate warted spores (Miller, 1979) and unusual cultural characters (Miller, 1971). The distinctive network of ridges on the pileus (Miller, 1979, pl. 89) makes it easily identified on sight. Singer (1975) places the monotypic species in Tribus *Rhodoteae* Imai in the Tricholomataceae Roze of the Agaricales.

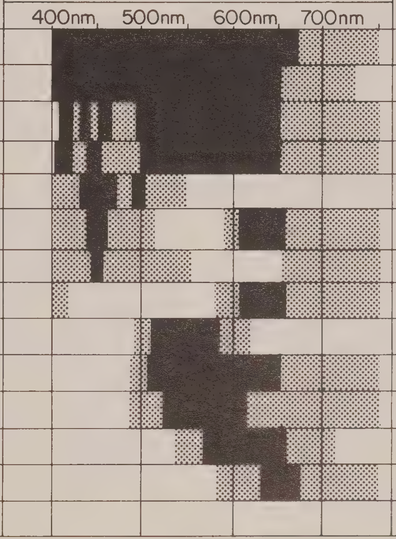
Field collecting by the senior author and herbarium collections by others indicate that it fruits sporadically throughout eastern North America during the summer and fall. Over its known range the species varies considerably in its size, pigmentation of the pileus and length of the stipe. In Michigan, for example, fruiting bodies collected in August, 1961, were pinkish orange, "buff pink", "light salmon orange" to "Grenadine pink" of Ridgway (1912); while in Maryland the pileus color of fruiting bodies collected in mid-October, 1969, was more orange to orange-pink, "orange pink" to "light salmon orange". The Maryland specimens were smaller and had a more variable stipe length than those in Michigan. The host in Maryland was tulip tree (*Liriodendron tulipifera* L.). Elm (*Ulmus americana* L.), basswood (*Tilia americana* L.), and red maple (*Acer rubrum* L.) were hosts in Michigan. In Europe, *Aesculus hippocastanum* L. the horse-chestnut, is one of the hosts. This species clearly has a wide host range.

In order to explore the range of pigment development and the phenotypic response of the fruiting body, a study of *R. palmatus* in culture was initiated. The objectives were to explore the effects of light intensity and light quality on the development and maturation of the fruiting body as well as the fungal mycelium.

METHODS

A polysporous isolate of *R. palmatus* (OKM 8237) was obtained from sporocarps growing on hardwood logs near Chesapeake Bay, Anne Arundel County, MD. The equipment and methods were those used to study *Panus fragilis* O. K. Miller by Miller and Palmer (1977) including the same temperatures, light and dark periods, and media. All 4 mm diameter inoculum plugs of mycelium and agar were cut from the advancing edge of a one-week-old colony grown at 16°C in the dark. Each plug was inverted so that mycelium was in

TABLE I SPOROCARP DEVELOPEMENT IN *RHODOTUS PALMATUS* EXPOSED TO DIFFERENT LIGHT INTENSITIES AND COLORS (400-750 nm).

FILTER		*	FILTER TRANSMISSION	MAXIMUM
NUMBER	COLOR	PERCENT	400nm 500nm 600nm 700nm	STAGE OF DEVELOPEMENT
	CLEAR	100		MYCELIUM
ES 849	PALE BLUE	60		MYCELIUM
ES 804	TINTED YELLOW	93		MYCELIUM
	CLEAR	100		MYCELIUM
RH 2424	BLUE	4		MYCELIUM
ES 837	MEDIUM MAGENTA	22		MYCELIUM
ES 866	DARK BLUE	2		PILEUS, MINUTE & STERILE
ES 821	LIGHT RED	16		PILEUS, FERTILE
RH 2092	GREEN	21		PILEUS, FERTILE
ES 809	STRAW	80		PILEUS, FERTILE
RH 2208	YELLOW	85		PILEUS, FERTILE
RH 2422	AMBER	61		PILEUS with long stipe, FER
RH 2423	RED	10		PILEUS, FERTILE
	NO LIGHT	0		LONG INITIALS

* PERCENT TRANSMISSION

▨ = TRANSMISSION < 0.5 K (K=1,000 microwatts/cm^2)

■ = TRANSMISSION 0.5 K OR > 0.5 K

contact with the fresh agar in the center of a plastic 90 mm Petri plate, which was immediately placed in the growth chamber. Two runs with two Petri plates each were made under each of eleven filters plus clear plexiglass (Table 1). Temperature was adjusted to 22°C. Transmissions of light within the growth chamber are presented for six filters that are significant (Figs. 1-6). Miller and Palmer (1977, Figs. 2-6) included similar scans of both monochromatic light and light transmitted within the growth chamber for each filter reported in Table 1. To insure constant darkness as a control, Petri plates were covered in three ways: black cloth, aluminum foil, and black cloth plus aluminum foil. Otherwise, conditions were identical to those for uncovered plates. To study the effect of increased nutrient base on the size of the sporocarp and the time required for mature sporocarps to develop, the fungus was grown in 2800 ml wide-bottom flasks each of which contained one liter of the malt-agar medium. Flasks received light through a yellow (RH 2208) filter or were kept in the dark.

RESULTS

Generative mycelium was white and soon became woolly around the inoculum plug. The mycelium grew at the rate of 2.6 cm in diameter per week, and a 90 mm Petri plate was covered in 24 days. A series of orange droplets usually developed on the mycelial mat about 5 to 25 mm from the edge of the plate in about 30 days. Within a day or two, minute white initials formed under the drops. This occurred in the dark or in the absence of high levels of blue light up to 500 nm and usually above 1.0 K. In the presence of light above 500 nm, one initial per plate enlarged, became orange, and expanded into a mature sporocarp with pileus, lamellae, and stipe (Fig. 8). Under most conditions the sporocarp has the orange to orange-pink reticulate or netted pileus, tuberculate spores, and other normal features of the fungus. The entire process from inoculation to sporocarp maturation takes about 45 days.

The stipe does not require light for initiation. Long stalks (initials) are produced in darkness (Fig. 7), but no mature or immature pilei develop (Table 1). Small amounts of light below 500 nm suppress development when mixed with larger amounts at 600 nm or higher (Table 1). This phenomenon is dramatically illustrated by the use of filter ES 866 (Fig. 3). Sporocarps with minute pilei (Fig. 10) on very short stipes were produced under this filter in very little light (2% transmission) that was largely in the blue range with some in the red (Table 1). Lamellae, but no basidiospores, were observed on these sporocarps and the same phenomenon occurred on sporocarps grown in low amounts of unfiltered light. In addition, small amounts of light at 600 nm do not offset more intense blue light (410-440 nm) (Table 1, Fig. 3).

Vegetative growth was also reduced in blue light. During both experiments, mycelium exposed under the clear filter to high light intensity and ES 849 (60% transmission) failed to grow over the entire plate. Under the other filters at lower levels of blue light (ES 804, ES 837, RH 2424 and clear low intensity), however, vegetative growth completely covered the plates. In only one case were initials produced in light from 400 to 450 nm at or above 0.6 K (ES 866, Table 1).

Normal sporocarps and basidia with basidiospores develop when blue light was excluded or reduced to a very low level as in ES 821 (Table 1). Light in the green, yellow, or red range was equally effective for the production of a mature fruiting body, and in fact the spectrum transmitted through RH 2092 does not overlap with that through RH 2423 (Figs. 4 and 6). However, the lifeform and pigmentation of the pileus cuticle vary. Under green light (RH 2092) the pileus was usually about 10 mm broad at maturity, pale orange in color, with well developed ridges and pits (Fig. 8). The stipe was straight and 18-22 mm high. Under amber light (RH 2422) the pileus was also about 5-10 mm broad, with very obscure reticulations and a bright orange color. The stipe, however, was very long (50-65 mm) and flexuous (Fig. 9). Those produced under yellow (RH 2208 and ES 809) filters had orange-pink pilei, 8-15 mm in diameter with well developed ridges and pits. The stipe was straight and ranged between 10-22 mm in length.

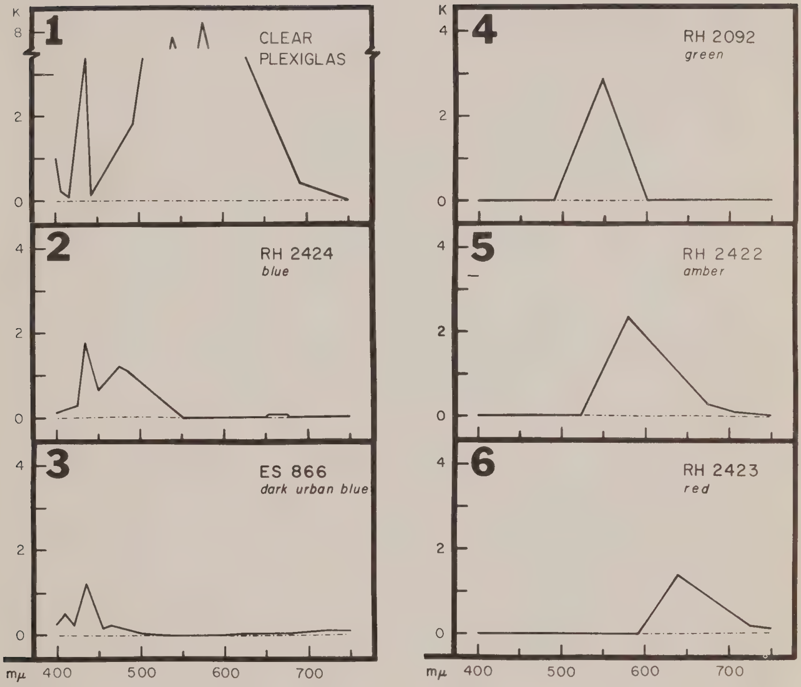
Sporocarps grown in the large flasks under yellow light (RH 2208) resemble in size, statue, form, and color those encountered in nature. The stipe was longer (60-90 mm), but the diameter about the same as those found in nature, 5-7 (-10) mm. Mature caps were consistently 18-22 mm in diameter which is within the lower size range of those found in nature.

DISCUSSION

Phenotypic responses of *Rhodotus palmatus* to different wavelengths of visible light result in substantial modifications of form and color of the fruiting body. For example, amber light (Filter RH 2422, Table 1) resulted in the development of a fruiting body with an elongated, flexuous stipe (Fig. 3) and a bright orange, small pileus with obscure reticulations. Under green light (Filter RH 2092, Table 1) on the other hand, the fruiting body had a short, straight stipe (Fig. 2), and a pale orange, large pileus with well developed ridges and pits. Under both conditions, normal basidia and spores were produced. The Michigan fruiting bodies, noted earlier, collected under a canopy of green leaves, had soft pinkish-orange colors in the pileus similar to those associated with the green filter while those fruiting in October in Maryland, after the leaves had fallen, were more orange to orange-pink in color. Since relatively high light intensities prevailed at the field sites, no particular differences in stipe length were noted.

Light at the blue end of the spectrum has been commonly associated with light-induced phenotypic responses in Basidiomycetes. Bulat (1954) investigated the production of pigment in cultures of *Dacrymyces ellisii* Coker. Coloration in sporocarps under field conditions varied from yellow to deep orange. A color range from white to buff to orange-buff and finally deep orange was produced in mycelium in culture at both 50 and 100 foot candles. It required at least 3 to 4 days to reach the maximum color intensity under both light intensities tested. The pigment did not form in the dark but once formed in the light it was not lost or modified by darkness. Both *Polyporus brumalis* Pers. ex Fr. and *Collybia* (*Flammulina*) *velutipes* (Fr.) Kummer "require light for normal cap development" (Plunkett, 1958). However, *P. brumalis* attained larger cap diameters as light intensities increased but the stipes were often considerably longer than usual in low light levels. Of interest is the fact

Figs. 1-6. Quantities of light (K = 1,000 microwatts/cm^2) between 390 and 750 nm radiated from cool white fluorescent lamps and transmitted through six pigmented filters (RH = pigment in plexiglass; ES = pigment in cellulose acetate supported by clear plexiglass).


K
8
2
0
1
CLEAR
PLEXIGLAS
4
2
0
2
RH 2424
blue
4
2
0
3
ES 866
dark urban blue
mμ
400
500
600
700
K
4
2
0
4
RH 2092
green
4
2
0
5
RH 2422
amber
4
2
0
6
RH 2423
red
mμ
400
500
600
700

that similar responses may be induced by other factors, e.g. *Collybia velutipes* had elongated stipes and reduced cap sizes in response not to light but to "as little as 1.8% of carbon dioxide". Sporocarp initiation and/or development, subsequent maturation of the hymenium, and the production of fertile spores are other responses generally occurring in the presence of blue light (Alasoadura, 1963; Borriss, 1934; Aschan-Aberg, 1960; Ingold and Nawaz, 1967; Barnett and Lilly, 1952: and Miller and Palmer, 1977). Blue light, according to Borriss (1934), induces phototropism in *Coprinus lagopus* (Fr.) Fr.

By contrast, *Rhodotus palmatus* responds at the red end of the spectrum. The maturation of the sporocarp and development of the spores take place when there is light only at the red end of the spectrum, i.e. above 490 nm (Table 1). In addition, the phenotypic characteristics, e.g. color, stipe length, and pileus size, vary considerably with changes in the red end of the spectrum (Table 1). Consequently, when screening isolates for the induction of fruiting bodies with fertile hymenia but unknown requirements, it is necessary to use the red as well as the blue end of the spectrum. There also appears to be a necessity to have a rather high level of light over extended periods of each day. No attempt was made to define the necessary quantity of light nor the amount required per day. However, it can be seen from Table 1 that successful fruiting of *Rhodotus palmatus* was attained using a day length of 12 hours with 1.2 to 3.5 K (1000 microwatts per cm^2) of light.

In summary, in order to properly interpret the variation in the characteristics of a given fungus species, the range in phenotypic responses must be studied. In the absence of this type of investigation, the change in the shape, size, and pileus color of *Rhodotus palmatus* might be assumed to be species specific differences. In fact,

Figs. 7-10. Fruiting responses of *Rhodotus palmatus* in dark and light: Fig. 7. Initials formed in dark. Fig. 8. Mature sporocarps having lamellae with basidiospore-bearing hymenia produced in green light (Filter RH 2092). Fig. 9. Fruiting bodies with elongated stipes developed in amber light (Filter RH 2422). Fig. 10. Infertile sporocarps with small pilei and short stipes produced at low quantities of blue and red light (Filter ES 866).

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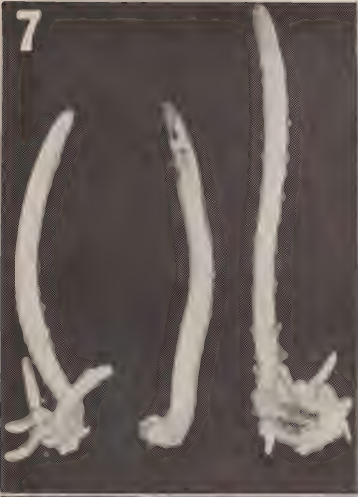

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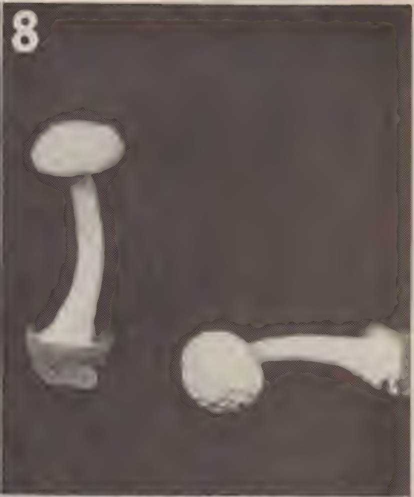

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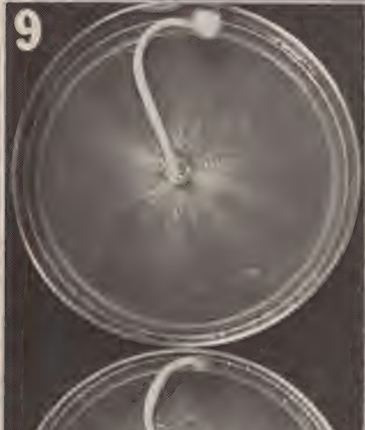

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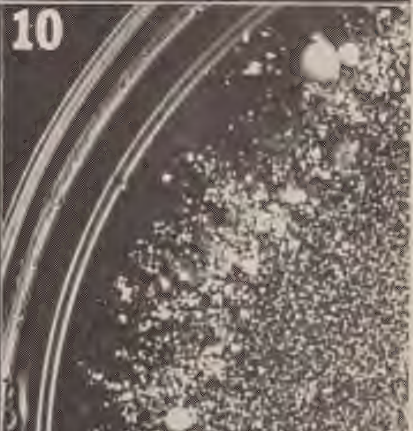

however, very plastic species under different abiotic influences will exhibit wide variation in their phenotype as reported by Miller (1971) for *Lentinellus cochleatus* (Pers. ex Fr.) Karst., in contrast to more conservative responses of other taxa. Lastly, any attempt to induce Homobasidiomycetes to fruit in culture must take into account the fruiting response reported here in the presence of red light rather than the usual fruiting requirement for blue light.

ACKNOWLEDGMENT

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MYCOTAXON

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NEW COLLECTION AND NEW LOCALITY IN CHILE FOR CHLAMYDOPUS MEYENIANUS (KLOTZSCH) LLOYD (GASTEROMYCETES)

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Rodulfo A. Philippi collected samples of Gasteromycetes in northern Chile (1853-54) that he classified as *Tulustoma deserticola*. These samples were collected between Cachinal de la Sierra and Agua de Profeta (24°54' S and 69°07' W), elevation 9000 ft. I am not aware where the original Philippi samples were located. In this note I report a new collection of *T. deserticola* in northern Chile.

The specimen (Fig. 1) was collected by Luis Robres in December 1972, in Quebrada del Inca, between Ollagüe and Amincha (21°12' S and 68°17' W), Prov. El Loa, in a bare non-saline south-facing site. The sample collected by Robres corresponds to *Chlamydopus meyenianus* (number 10997, Herbarium Manuel Mahú). The irregular lacerations of the dehiscence of the endoperidium (Fig. 2) is not observed in Philippi's original drawing of *T. deserticola* (Synonym of *Ch. meyenianus*) where the dehiscence is circular and flat. Other characteristics such as colour, texture, stipe furrowing and size of spores (5-6 μ) agree with the characteristics given for the species. The capillitium is expanded at the bifurcations (Fig. 3).

Figure 1. Herbarium sample (Mahú 10997, original) of *Ch. meyenianus*. The size in the picture is natural.

Figure 2. Upper view of endoperidium of *Ch. meyenianus* showing the dehiscence of the ostiole. (x 2.5, Mahú 10997, original).

Figure 3. Spores and capillitium of *Ch. meyenianus* (x 400, Mahú 10997, original).

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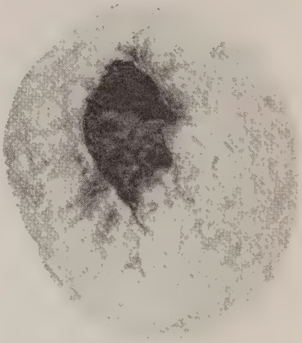
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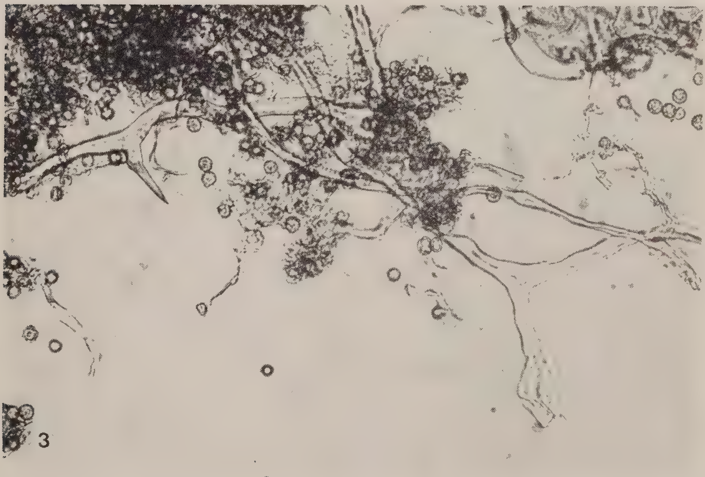
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The habitat of this species is dry or semiarid, sandy, volcanic soil gypsum flats (Spegazzini, 1899; Long and Stouffer, 1946 and Guzmán and Herrera, 1969). This fungus grows solitary in an open land, with little vegetation. Our sample was also found in a place with these characteristics.

I wish to thank Prof. Waldo Lazo and Dr. Luis Corcuera for revising an earlier draft to the manuscript.

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MYCOTAXON

Vol. XI, No. 2, pp. 423-424 July-September 1980

ON THE CORRECT AUTHOR CITATIONS FOR CERTAIN SPECIES OF *PHAEOPHYSCIA*

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It was an unfortunate coincidence that during the year 1978, three different authors published several of the same new combinations in the genus *Phaeophyscia.* Esslinger (1978) and Moberg (1978), both transferred *Physcia hispidula* (Ach.) Frey, *Physcia hirsuta* Mereschk. and *Physcia rubropulchra* (Degel.) Moberg into *Phaeophyscia*, and Awasthi (1978) transferred *Physcia hispidula* into that genus. The apparent approximate dates of publication of all these new combinations are very close, and I have therefore made further inquiries to more accurately fix the actual date of effective publication for each of the papers involved.

Effective publication in the nomenclatural sense is dated not from the time of printing, but from the actual date of distribution to the public (Art. 29 of the I.C.B.N.). The date that appears on some journals when first distributed, is in reality the approximate date of printing, and the actual date of distribution may vary rather greatly from this. In the case of the *Phaeophyscia* combinations presently under consideration, the date of effective publication for those appearing in the July-September issue of Mycotaxon (Esslinger, 1978) is actually very close to July 13th (the official issue date for that number as published on the next issue of the journal). This apparently represents the actual date of mailing, because I received my personal copy on the 17th of July. Other American subscribers undoubtedly received their copies within a few days of July 17th as well. The issue of Botaniska Notiser which contains Moberg's new combinations

(Moberg, 1978) bears the date of June 30th. Information from the editor of that journal, however, indicates that although vol. 131, #2 was printed at the end of June (in Lund), it was not bound and distributed (from Stockholm) until the middle of August. The library at the Botanical Museum in Lund received their copy on August 25th, which is therefore probably the earliest possible date for effective publication of that issue. I have received official word from the editors of the Indian Journal of Forestry that the actual date of distribution for vol. 1, #2 containing Awasthi's new combination for *Ph. hispidula*, was the 25th of July. The new combinations made by me in Mycotaxon therefore predate those of both Moberg and Awasthi.

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Awasthi, D.D. 1978. The lichen flora in the environs of Gangotri and Gomukh, India. I - The Macrolichens. Indian Journal of Forestry 1(2):138-146.

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Moberg, R. 1978. Overlooked names and new combinations in *Phaeophyscia* (Lichenes). Botaniska Notiser 131(2):259-262.

MYCOTAXON

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TRICHOLOMA TITANS, A NEW SPECIES FROM FLORIDA

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SUMMARY

A number of collections of a mushroom with extremely large basidiocarps has been found largely on disturbed land sites in Florida. It was determined to be a new species of *Tricholoma* which we are naming *T. titans*.

Within the past decade several collections of an extremely large agaric have been found in central and north-central Florida. Because of the large size (up to 75 cm) and peculiar habitat (disturbed land sites) of this agaric, it has aroused the interest and curiosity of mycologists in the area (Eilers et al., 1980). These workers concluded that the giant mushrooms were a species of *Tricholoma*, perhaps representing a new species. General macroscopic and minor microscopic features were described and several aspects of the habitat and distribution of the species were discussed. Further observations of microscopic and microchemical properties of several collections confirm that the agaric is an undescribed species of *Tricholoma*. We propose the following new species:

Tricholoma titans Bigelow & Kimbrough, sp. nov. Figs. 1-3

Pileus (2.5-)12.5-48(-75) cm latus, convexus tandem planus; margine demum irregularis in vetustae; discus demum depressus; superficies uda vel sicca sed haud hygrophana; saepe maculata vel squamulosa super disco, pallide bubalinae vel cremeae; contextus crassus ad discus, albidus, firmus sed lentus. Odore et sapore mitis. Lamellae sinuatae vel emarginatae, confertae, angustae tum sublatae, albidae vel eburneae, interdum fucatae. Stipes 7-20 cm longus; apices 1.7-3.2 cm latae; basis 2.5-12.5 cm crassus, clavatus vel bulbosus vel turbinatus; superficies lanuginosae sursum, deorsum squamulosae vel scabrosae, albidae tum sordidobubalinae; solidus, albidus intra. Sporae (5-)6-7(-8) x 4-5(-5.5) μm, in cumulo albidae. Pleurocystidia plerumque rostrati. Hyphis fibulatis.

Holotypus legit Tavares, Lake Co., Florida, on sandy soil beneath oaks, Jackson A. Haddox, August 14, 1978, FLAS F 51990.

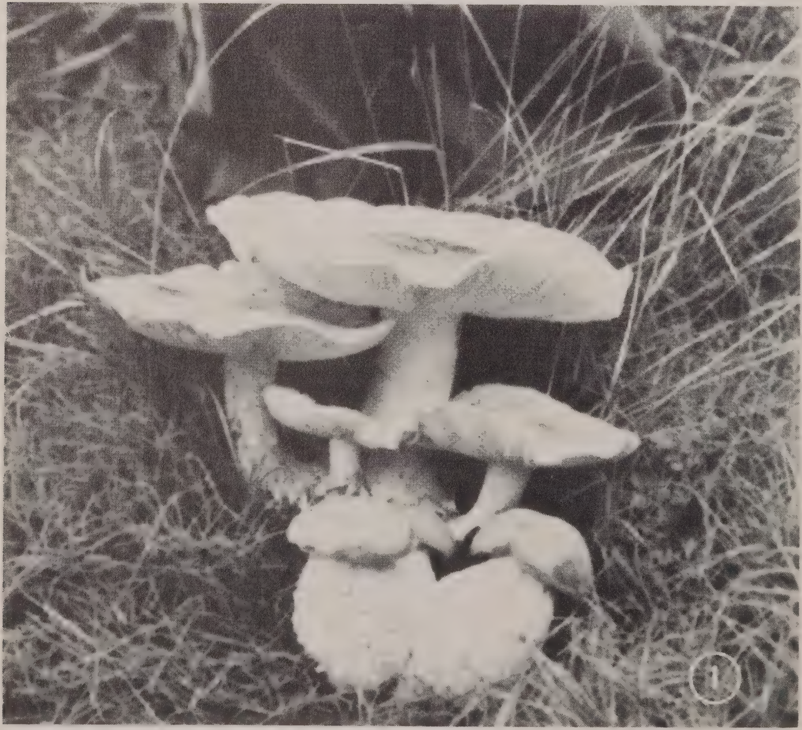

Fig. 1. *Tricholoma titans*, X 1/4.

Pileus (2.5-)12.5-48(-75) cm broad; obtuse to hemispheric at first but soon becoming convex or broadly convex, finally plane; margin incurved and inrolled at first, remaining narrowly inrolled for some time, undulate and/or lobate, uplifted in age, not striate; disc becoming depressed in age; surface moist or dry but not hygrophanous, dull, often with a few watery spots or small appressed scales on disc, glabrous elsewhere; color pale buff to cream ("cream color"[1] near margin to "cream buff" on disc), darkening slightly in age; context thick on disc, tapering gradually to the margin, white, firm but pliable. Odor mild (pleasant and fungoid). Taste mild or nutty.

Lamellae sinuate or sharply notched with a tooth, seceding, close or crowded, narrow at first then moderately broad (3-12 mm), whitish to ivory color (dingy "ivory yellow"), with brownish stains at times, edges somewhat undulate, brittle in age.

Stipe 7-20 cm long, apex 1.7-3.2 cm broad, base 2.5-12.5 cm thick, clavate to bulbous or napiform; surface woolly at the apex, appressed in age, squamulose or with concentric scabrous rings below, whitish at first then dingy buff with age and bruising; solid, white within, cortical region firmer than interior but not differing in color. Veils absent.

Spores (5-)6-7(-8) x 4-5(-5.5) µm, broadly ellipsoid or ellipsoid, smooth, often uniguttulate, walls acyanophilic but contents often cyanophilic, inamyloid, walls slightly thickened at times; deposit white. Basidia 25-28 x 5-7 (-8.5) µm, usually 4-spored, occasionally also 1- or 2-spored, sterigmata prominent (up to 6.5 µm long), siderophilous granules absent. Pleurocystidia broadly fusoid to distinctly rostrate, 28-46 µm long, 7-18 µm broad in widest portion, beak 2-2.5 µm broad, protruding 20-35 µm beyond basidia, hyaline, thin walled; cheilocystidia like pleurocystidia when present. Pileus: epicutis of interwoven hyphae, 2-4(-6) µm broad, often branched, cells short (ca. 20-50 µm long), walls thin or slightly thickened, rarely finely encrusted on disc; context hyphae cylindric, 2-8 µm diam near pileus margin, cylindric or slightly inflated at disc, 8-19 µm diam, walls usually thin, oleiferous hyphae present but very scattered. Clamp connections present. Hymenophoral trama of parallel hyphae, cylindric to inflated, 2-15 µm diam, mediostratum conspicuous only in broad lamellae, walls thin, subhymenium appearing ± cellular. Caulocystidia absent.

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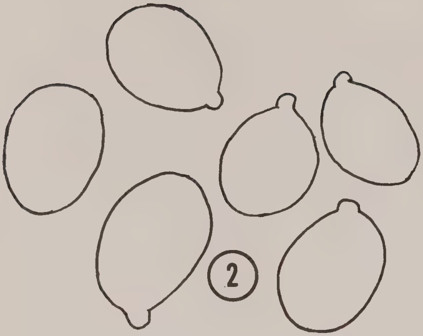
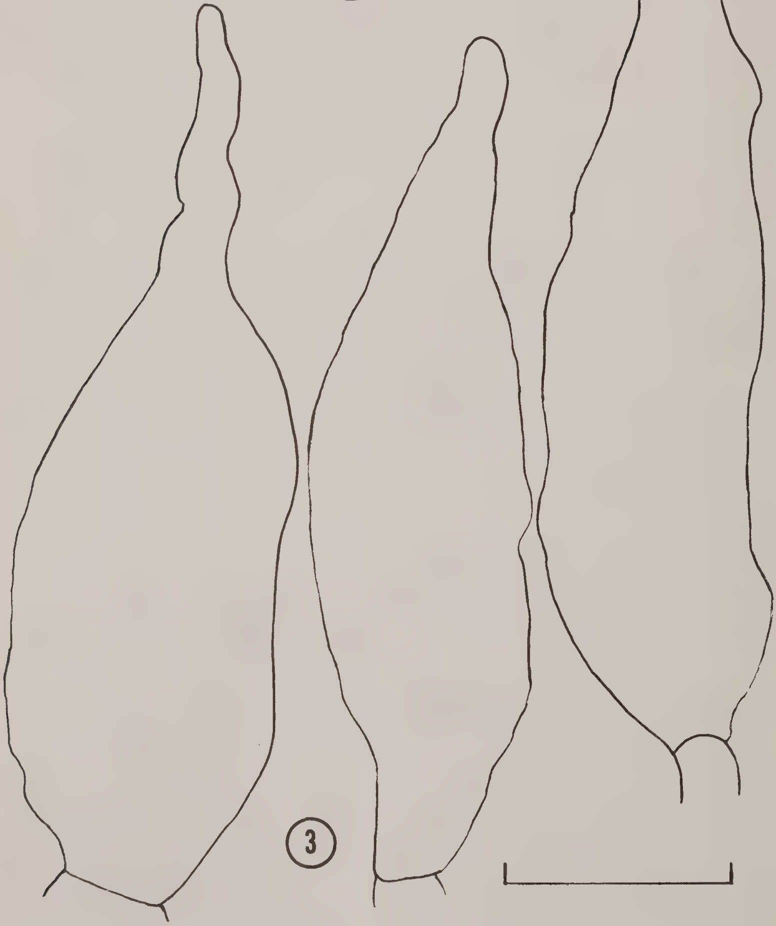
[1] Ridgway, R. 1912. Color standards and color nomenclature. Publ. by the author, Washington, D.C.



②



③

Solitary or cespitose. On sandy soil attached to buried roots and wood, in the open on grassy sites or in low herbaceous growth. August and September.

Material examined: Florida: Bigelow 18059 (MASS); Hansens F 49622 (FLAS); Woodruff F 49623 (FLAS); Winchester F 51796 (FLAS); Little F 52109 (FLAS); Benny F 52110 (FLAS); May F 52111 (FLAS); Haddox F 51990 (FLAS-TYPE).

The species with which *Tricholoma titans* is most likely to be confused is *Clitocybe gigantea* (Fries) Quélet (= *Leucopaxillus* ss. Singer et al.), but this has distinctly decurrent lamellae, an infundibuliform pileus when mature, and spores which have amyloid walls. Cystidia are absent on the lamellae as well.

Due to the fleshiness and broad lamellae of *T. titans*, it is often difficult to make good hand sections. The changes in structure due to the expansion of elements can also provide problems in observation and interpretation. When relatively small basidiocarps are examined, the pleurocystidia are numerous and protrude beyond the basidia in a very conspicuous fashion, but in large specimens the pleurocystidia are scattered and mostly embedded. Apparently the elongation of basidioles and the increase in diameter of hyphal elements in the hymenophoral trama are responsible for this phenomenon. The occurrence of cheilocystidia also can be confusing. In basidiocarps with narrow lamellae, cheilocystidia of the same type as the pleurocystidia can be found intermixed with basidioles, but as the lamellae increase in width the hymenial elements are greatly dispersed at the edge by the outgrowth of tramal hyphae. This results in the broader lamellae having peculiar and varied hyphal ends in the place of most basidia and cystidia. The hyphal ends have no specific type of end cell and they may assume various contorted and irregular shapes. Adding to the difficulty of interpreting the microscopic structures of the lamellae are the presence of immature pleurocystidia and basidioles which have not attained the characteristic shape.

LITERATURE CITED

Eilers, F. I., D. TeStrake Wagner-Merner, and J. W. Kimbrough. 1980. Rare occurrences of large mushrooms (*Tricholoma* sp.) in Florida. Florida Sci. 43: 50-54.

Figs. 2, 3. *Tricholoma titans*. 2. Spores. 3. Pleurocystidia. Standard line = 10 μm.

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NOTES ON CORTICIACEAE (BASIDIOMYCETES) VII.

A synopsis of the genus Amylocorticium Pouz.

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SUMMARY

Eight species of Amylocorticium are listed alphabetically with brief comments on microscopical characteristics. A key to known species is presented. The generic description is based on Eriksson and Ryvarden, 1973.

AMYLOCORTICIUM Pouz., Česká Mykol. 13(1):11, 1959.

Type species: Peniophora subsulphurea (Karst.) Höhn.& Litsch. - Xerocarpus subsulphureus Karst.

Pouzar recognized five species and in his opinion the genus could be divided into two groups with A. subsulphureum and A. subincarnatum in the first and A. cebennense, A. rhodoleucum, and Peniophora mollis in the second group.Since then three species have been incorporated or described, viz.: A. canadense, A. indicum, and A. suaveolens, which are similar to the first group. Furthermore, Corticium laceratum was recollected in N. Europe and found by Hjortstam and Ryvarden (1979) to have amyloid spores and they therefore referred it to the genus.
Pouzar did not make any formal combination for P. mollis and Corticium rhodoleucum but the latter was adopted by Eriksson and Ryvarden in 1976. P. mollis still lacks a suitable generic name in the modern system as it was not accepted in Leucogyrophana by Ginns (1978).

Generic description.

The genus Amylocorticium is characterized by smooth, distinctly amyloid spores. Cystidia occur in some species but are only slightly differentiated, almost hyphalike. The basidia are clavate, more or less constricted and bear four sterigmata. The hyphal system is monomitic with distinct, loosely interwoven hyphae with clamps at all septa, except in one species; hyphal branches occur mainly from the clamps.

Young fruitbodies have a slight tendency to be athelioid. The spores are either narrowly ellipsoid or subcylindrical-allantoid, usually not more than 2.5 um broad.

Special literature: Pouzar (1959), Eriksson and Ryvarden (1973), Rattan (1977), and Weresub (1974, 1976, and 1977).

Key to the species:

1. Cystidia present 2
1. Cystidia absent 4

2. Spores ellipsoid, normally 4.5 - 5.5 um long *A. subincarnatum*
2. Spores subcylindrical to narrowly ellipsoid, (5.5-) 6 - 8(-10) um long 3

3. Spores 5 - 6(-7) um long, fruitbody yellowish or slightly reddish, with a pleasant scent *A. suaveolens*
3. Spores generally 7.5 - 8 um, fruitbody normal yellowish, without a pleasant scent *A. subsulphureum*

4. Hyphae without or with few clamps, but with numerous hooks, rare species *A. rhodoleucum*
4. Hyphae with clamps at all septa 5

5. Fruitbody thin, separable in small pieces, basidia stalked, hyphae narrow, 1.5 - 2.5 um broad *A. laceratum*
5. Fruitbody thicker, basidia not stalked, hyphae 2.5 - 4 um broad 6

6. Spores subcylindrical to allantoid, usually 1.5 - 1.75 (-2)um broad, fruitbody whitish *A. cebennense*
6. Spores subcylindrical to narrowly ellipsoid, 2 - 2.25 um broad, fruitbody yellowish or brown 7

7. Spores 4.5 - 5.5 um long, at first amyloid then becoming dextrinoid *A. indicum*
7. Spores generally 6 - 7 um long, no dextrinoid reaction observed *A. canadense*

A. CANADENSE (Burt) Erikss. & Weres., Fungi Canadenses No. 45, 1974. - *Corticium canadense* Burt, Ann. Miss. Bot. Gard. 13:290, 1926. - Fig. A.

Rather well separated from other species in the genus in lacking cystidia, but compare *A. indicum*.
The spores are narrowly ellipsoid, generally 6 - 7(8) x 2 - 2.25 um, ratio of length/width 3.3:1.
In some specimens of *A. subsulphureum* it may be difficult to find cystidia and such collections are similar to and hardly separated from *A. canadense*.

A. CEBENNENSE (Bourd.) Pouz., Česká Mykol. 13(1):11, 1959. - *Corticium cebennense* Bourd., Rev. Sci. Bourb. Centr. France, 23:7, 1910. - Fig. F-H.

Fruitbody more membranaceous than in other species of the genus, hymenium creamish or becoming light yellow when dry. It is rather uniform in the morphology of hyphae and basidia but the spores vary considerably. In some specimens they are short and narrow, 5 - 5.5 x 1.5 - 1.75 um, in others more normal, 6 - 7.5 x 1.75 - 2(-2.25) um, and in e.g. Ryv. 14994 from Spain up to 8 - 9(-10) x 1.75 - 2 um. At present it seems to be convenient to allow the species a wide interpretation.

A. INDICUM Thind & Rattan, Trans. Brit. Mycol. Soc. 59:125, 1972. - Fig. D.

The species is recognized by lacking cystidia and in having more or less ellipsoid spores, 4.5 - 5.5 x 2 - 2.25 um, ratio length/width 2.2 - 2.4:1. According to Thind and Rattan the hymenium is yellow when fresh, fading to cream - yellow on drying.
Notable is my observation of the dextrinoid spore reaction in Rattan´s collection 5348. The spores are at first distinctly amyloid, then become more or less dextrinoid. It is similar to A. canadense but seems to be rather well distinguished by shorter spores. As far as known not collected outside India.

A. LACERATUM (Litsch.) Hjortst. & Ryv., Mycotaxon 10:206, 1979. - Corticium laceratum Litsch., Ann. Mycol. 39: 118-119, 1941. - Fig. I.

The morphology of the basidia is unlike those of other species in the genus. As pointed out by Eriksson and Ryvarden (1973) the basidia are stalked and furthermore resemble those of the genus Athelopsis. The spore walls are, however, amyloid, which hitherto has been used as an important character for generic separation. This was the main reason why Hjortstam and Ryvarden incorporated the species in Amylocorticium. Further studies of this rare species may alter the position.

A. RHODOLEUCUM (Bourd.) Erikss. & Ryv., Norw. Journ. Bot. 23:61, 1976. - Corticium rhodoleucum Bourd. Rév. Scient. Bourb. 1922, 1:14, 1922.

Eriksson and Ryvarden (1976) gave a good illustration and description of this obviously rare species. As far as I know, the fungus has only been collected in France and additional specimens are needed for a better knowledge of the relationship to A. cebennense and other species in the genus.
Reid (1965) selected Bourdot 12363 (P) as lectotype.

A. SUAVEOLENS Parm., Consp. Syst. Cort. 197 - 198, 1968. - Fig. E.

This species may be separated from A. subsulphureum by slightly shorter spores. Cystidia occur but are rather few

in the type collection. The spores measure 5 - 6(-7) x 2 (-2.25) um, ratio of length/width 2.5 - 3:1.
I have not been able to observe the pleasant scent which was described by Parmasto.

A. SUBINCARNATUM (Peck) Pouz., Česká Mykol. 13(1):11, 1959. - Corticium subincarnatum Peck, N.Y. St. Mus. Ann. Rep. 41: 124, 1889. - Fig. C.

Spores ellipsoid, (4-)4.5 - 5.5(-6) x 2.25 - 2.5(-3) um, ratio of length/width 2.2 - 2.5:1.
In some specimens seen the spores are at first distinctly amyloid, then become more or less brownish, but not dextrinoid as in A.indicum. Rather well separated from A. subsulphureum by smaller spores and by a yellowish-reddish hymenium.

A. SUBSULPHUREUM (Karst.) Pouz., Česká Mykol. 13(1):11, 1959. - Corticium subsulphureum Karst., Medd. Soc. Fauna Fl. Fenn. 6:12, 1881. - Fig. B.

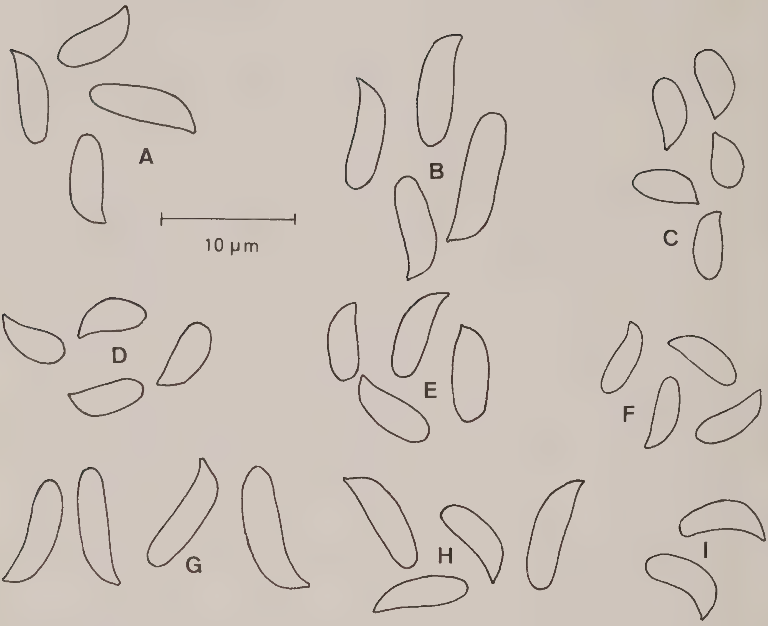
Spores subcylindrical to narrowly ellipsoid, generally 7.5 - 8 x 2 - 2.25 um, sometimes up to 8.5 - 9.5 x 2.5 um, ratio of length/width 3.4 - 3.6:1.
The cystidia are easily recognized, hypha-like and septate, always with clamp at the septum.

CORTICIUM SULPHUREO - MARGINATUM Litsch., Ann. Mycol. 32: 52, 1933.

According to Eriksson and Weresub (1974) this species probably is a synonym of A. canadense.

Specimens used for drawings:

Fig. A. A. canadense. U.S.A. Connecticut, Salisbury, on Pinus strobus. 1931-10-13. P. Spaulding, det. H.S.Jackson. (GB).
Fig. B. A. subsulphureum. Norway. Nordland, Rana, Reinforshei, ab. 10 km N of Rana in Dunderlandsdalen, on Picea abies. 1976-09-12. Leif Ryvarden 13813. (O).
Fig. C. A. subincarnatum. Sweden. Småland, Rumskulla par., N.Kvill Nat. Park, on fallen trunk of Picea abies. 1966-09-10. Berit & John Eriksson 7337. (GB).
Fig. D. A. indicum. India. Bagi, Mahasu, Himachal Pradesh, on a log of Abies pindrow. 1967-10-13. S.S. Rattan 5348. Paratype. (K).
Fig. E. A. suaveolens. R.P.S.S.A. Komi, Graddor, on Picea obovata. 1957-08-06. E. Parmasto 8264. Part of holotype. (GB).
Fig. F. A. cebennense. Norway. Hedmark, Løten, near Koietjern, on coniferous wood. 1978-09-03. Even Høgholen 851/78. G. Spain. Huesca Prov., 11 km N of Hecho in Abies forest, 1100 m, on Pinus sp.1977-11-10. Leif Ryvarden 14994. H. Norway. Hedmark, Rendal, Mistereggen, on Picea abies. Leif Ryvarden 7050. All specimens in (O).
Fig. I. A. laceratum. Sweden. Bromma, Stockholm, on decayed conifer wood. 1918-04-21. Lars Romell 3990. Holotype. (S).



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Weresub,L.1976 and 1977: Fungi Canadenses No.87 and 91. Ottawa.

MYCOTAXON

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ADDITIONS AND CORRECTIONS TO THE ANNOTATED INDEX TO FUNGI DESCRIBED BY N. PATOUILLARD

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Since the publication of the Annotated Index to Fungi Described by N. Patouillard (Pfister, Contrib. Reed Herb. 25: iii-v, 1-211. 1977), I have had the opportunity to continue work on the Patouillard herbarium at the Farlow Herbarium in Cambridge and to visit the Laboratoire de Cryptogamie at the Muséum National d'Histoire Naturelle in Paris where other Patouillard specimens are deposited. With these additions probably most of the extant type material is accounted for. Many specimens for which material has not been located date from Patouillard's early work. The most notable of the missing specimens are those which were described in the Tabulae analyticae fungorum 1883-1889. These exist neither in the Patouillard herbarium (FH) nor in the general mycological herbarium at PC.

A few generalizations may now be made. The material collected by DeCary in Madagascar and studied by Patouillard is at PC. Most of the specimens are accompanied by field drawings and notes. Many of the drawings are accurately prepared and are diagnostic. There are specimens or duplicate specimens at PC of material jointly described by Hariot and Patouillard. Most of the collections from Maroc published in Pitard (1931) are also to be found in PC. Many duplicates of Gaillard collections from Venezuela are present in PC. I was not able to locate Duss collections from Guadeloupe or Martinique.

PC specimens were sought under the basionym and obvious synonyms, still specimens might have been overlooked. Those requesting PC specimens should give complete synonymy. Another explanation for some of the missing specimens might lie in Patouillard's use of manuscript and herbarium names. These are difficult or impossible to trace particularly in light of the number of taxa Patouillard described. In cataloging the material at FH, a number of such herbarium names were encountered.

My work at PC was made possible by a grant from the Clark Fund, Harvard College, and the American Philosophical Society. Without these funds the work would not have been possible.

Specimens in PC are noted below. A plus sign (+) indicates additional comments from FH collections.

acris Pat.	Boletus	with drawing
adenocarpi Pat.	Diplodia	
aframomi Har. & Pat.	Uredo	
agavectonum Pat. & Har.	Dimerosporium	
albipes Pat.	Boletus	with drawing
alliiodora Pat.	Amanita	
andromedae Pat.	Meliola	
annamensis Pat.	Favolus	
f. annamitica Pat.	Ungulina dochmia	
annamiticus Pat.	Spongipellis	
asperulus Har. & Pat.	Leucoporus	
atrospora Pat.	Anixia	
auricomus Pat.	Coprinus	
avellaneus Pat.	Cantharellus	with drawing
baccharidis Pat.	Polyporus	+Also in Höhnel Herb.
baguirmiensis Har. & Pat.	Lentinus	
balansae Max Cornu ex Pat.	Aecidium	
bambusinus Pat.	Polyporus	
barlae Boud. & Pat.	Helvella	
baudonii Pat.	Polyporus	
bicolor Pat.	Cordyceps	
bolaris Pat.	Phellinus	
brevipes Pat.	Melanopus	under M. hemicapnodes
brunneolum Pat.	Helotium	under Lambertella
bryophilus Pat.	Xanthochrous	

buissonii Pat.	Ganoderma	
caesariatus Pat.	Lentinus	
caledonicus Pat.	Hypomyces	with extensive notes by Patouillard but collection data not clear
calóspora Pat. & Gail.	Erinella	
calospora Pat.	Zignoella	
chaperi Pat.	Ganoderma	
chevalieri Har. & Pat.	Tylostoma	
chevalleri Har. & Pat.	Amanita	
chudaei Har. & Pat.	Lentinus	
cinerella Pat.	Russula	
cinereoalbus Pat. & Gail.	Pleurotus	
conigeum Pat.	Caeoma (Peridermium)	
corrugata Pat. & Har.	Daldinia	
corticola Pat.	Amphisphaeria	
cubensis Har. & Pat.	Zignoella	
daemiae Har. & Pat.	Aecidium	
decaryi Pat.	Boletus	with drawing
decaryi Pat.	Geaster	
decaryi Pat.	Leptoporus	
decaryi Pat.	Physalacria	
decaryi Pat.	Pterula	
decaryi Pat.	Stropharia	
decaryi Pat.	Sarcosoma	
discipes Pat.	Calocera	with drawing and notes
doassansii Pat.	Cordyceps	
elastica Pat. & Gail.	Phaeopezia	
eryngii Pat.	Didymosphaeria	with drawings and notes
erythrophylla Pat.	Lepiota	

fibula Pat.	Sarcosoma	
ficicola Pat.	Phyllosticta	
flosterrae Pat.	Mylitta	
frondosum Pat.	Ganoderma	
furcata Pat.	Asterina	
fuscoatra Pat.	Laschia	
fuscobrunneum Pat. & Gail.	Helotium	
gaillardi Boud. & Pat.	Lilliputia	PC Herb. Boudier
glomerata Pat.	Fracchiaea	
granulata Pat.	Pistillaria	
graveolens Pat.	Boletus	with drawing
helianthemi Pat.	Ascochyta	
heribaudii Har. & Pat.	Nidularia	
hololeucum Pat.	Hydnum	
holothejus Pat.	Boletus	with drawing
hyphaenes Har. & Pat.	Pilacre	
hypochaeridis Pat.	Septoria	
hyphophylli Pat.	Phyllosticta	
var. incisum Pat.	Schizophyllum mexicanum	
inverseconicus Pat.	Lentinus	with drawings by Patouillard of microscopic features
iocephala Pat.	Daedalea	
iodoformica Pat.	Psilocybe	
iridicola Pat.	Ascochyta	
irpicina Pat.	Dictyophora	
isabellinus Pat. & Gail.	Polyporus	+Also in Höhnel Herb.
lacroixii Har. & Pat.	Cordyceps	
lanosa Pat.	Meliola	

latiporus	Melanopus	
lefebvrei Pat.	Phaeangium	PC Herb. Boudier
leptopodium Pat. & Har.	Scleroderma	
leucoceras Pat.	Lachnocladium	spec. from Guadeloupe collected by Bory de St. Vincent
leveillei Pat.	Asterina	
lignicola Pat.	Endogone	spec. from Guadeloupe collected by Duss
lignosum Pat.	Ganoderma	
lilliputianus Pat.	Boletus	with drawing
limoniastri Pat.	Pleospora	
lutea Pat.	Podoscypha	
macropus Pat.	Xanthochrous	
maculata Pat.	Phlyctospora	
madagascariensis Pat.	Cantharellus	
var. madagascariensis Pat.	Leucoporus rhizophilus	
var. madagascariensis Pat.	Leucoporus tricholoma	
madagascariensis Pat.	Xerotus	
magydaridis Pat. & Trab.	Puccinia	
maromandiae Pat.	Boletus	with drawing
melanocephalus Har. & Pat.	Xanthochrous	
menieri Pat.	Tomentella	
var. merismoidea Pat.	Podoscypha affinis	
microloma Pat. & Heim	Lentinus	
microspora Pat. & Gail.	Meliola	isotype in PC
minutula Pat.	Lepiota	
minutum Pat.	Caeoma	
minutus Pat.	Favolus	

mirbekii Pat.	Phoma	
murinacea Pat.	Amanita	
muscorum Roum. & Pat.	Ozonium	
mycenoides Pat.	Polyporus	
necator Pat. & Har.	Cordyceps	
neglectum Pat.	Ganoderma	
nitidula Pat. & Gail.	Phyllachora	
nummiforme Pat.	Helotium	with notes and drawings
obesa Pat.	Ungulina	+Also in Höhnel Herb.
ochroflavum Pat.	Hydnum	
oleae Pat.	Gloniella	
orientalis Pat.	Pheopezia [sic]	
orinocensis Pat. & Gail.	Erinella	
orinocensis Pat. & Gail.	Polyporus	
palmarum Pat.	Bagnisiella	
pancheri Pat.	Polyporus	under Melanopus
parthenii Pat. & Har.	Aecidium	
pavonius Pat.	Xanthochrous	
pelargonii Pat.	Sphaeropsis	Patouillard notes and drawings
pepli Pat.	Rhabdospora	
pernanum Pat.	Ganoderma	with drawing
perraldieri Pat. ex Pat.	Podaxon	
pezizoidea Pat.	Gibbera	
pleurocolla Pat. & Gail.	Cytospora	
var. pleuropodium Pat.	Ganoderma pullatum	
plorans Pat.	Xanthochrous	+Also in Höhnel Herb.

poilanei Pat.	Melanopus	two specimens
poilanei Pat.	Xerotus	
polygoni-sachalinensis Pat. & Har.	Puccinia	
praetervisum Pat.	Ganoderma	
pulchella Pat. & Har.	Clavariopsis	
pusillum Har. & Pat.	Polysaccum	
radicata Pat.	Podoscypha	
reticeps Pat.	Polyporus	
var. rhizophilus Pat.	Leucoporus arcularius	
rigida Pat.	Plicatura	
roseoalba Pat.	Lepiota	
roseobrunnea Pat.	Lepiota	
roseoisabellinus Pat. & Gail.	Polyporus	+Also in Höhnel Herb.
rubidus Pat. & Heim	Crinipellis	two specimens
rubiginosus Pat.	Crinipellis	with drawing
rubricosus Pat.	Polyporus	
rudis Pat.	Cyathus	
rufo-ochraceus Pat.	Polyporus	
rugosa Pat.	Pyronema	PC Herb. Boudier
salmoneus Pat.	Aleurodiscus	
schizoderma Pat.	Russula	with drawing
similis Boud. & Pat.	Clavaria	authentic spec. only
var. sphaerosporus Pat.	Agaricus variabilis	
stramineus Pat.	Spongipellis	
strychnicola Pat.	Amphisphaeria	
subcarcharias Pat.	Lepiota	with drawing
sulcatipes Pat.	Marasmius	
tetraspora Pat. & Gail.	Sphaerostilbe	

thejoleuca Pat.	Amanita	with drawing
tingitana Pat.	Torula	
tricholomum Pat.	Hyaloderma	
turbinatus Pat. & Har.	Leucoporus	
varians Pat.	Phylacteria	
violascens Pat.	Phellinus	
virescens Pat.	Lepiota	
waterloti Pat.	Hyalopsora	
waterloti Pat.	Xanthochrous	
zamurensis Pat. & Gail.	Humaria	
zizyphina Pat.	Phoma	
zollikoferiae Pat.	Sphaeropsis	with drawing and Patouillard notes

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NOTES ON HYPHOMYCETES. XXXVI
A NEW SPECIES OF *CUSTINGOPHORA*.

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ABSTRACT

Custingophora suidafrikana Morgan-Jones and Sinclair is described and illustrated from a collection made on decorticated wood in the Transvaal, South Africa.

INTRODUCTION

The genus *Custingophora* Stolk, Hennebert and Klopotek, type species *C. olivacea* Stolk, Hennebert and Klopotek, was described from an isolate obtained from compost in Germany (Stolk and Hennebert, 1968). The genus has remained monotypic since its establishment although Barr and Crane (1979) recognised the anamorph of *Chaetosphaeria aspergilloides* Barr and Crane as belonging to it.

A collection of a species of *Custingophora* has been made on decaying, decorticated wood in the northeastern Transvaal, South Africa. It is distinct from both *C. olivacea* and the conidial state of *C. aspergilloides.*

TAXONOMIC PART

Custingophora suidafrikana sp. nov. (Fig. 1).

Coloniae effusae, griseae vel atrae. Mycelium in substrato immersum, ex hyphis ramosis, septatis, subhyalinis vel pallide brunneis, laevibus, 2 - 3μm crassis compositum. Conidiophora macronemata, mononemata, erecta, recta, simplicia, ad apicem versus undata, laevia, brunnea, cylindrica, apicem inflata; stipes usque ad 230μm longus X 3 - 5μm crassa. Cellae conidiogenae monophialidicae, discretae, determinatae, leviae, pallide brunneae, lageniformes, 7 - 9 X 2.5 - 3μm. Conidia enteroblastica,

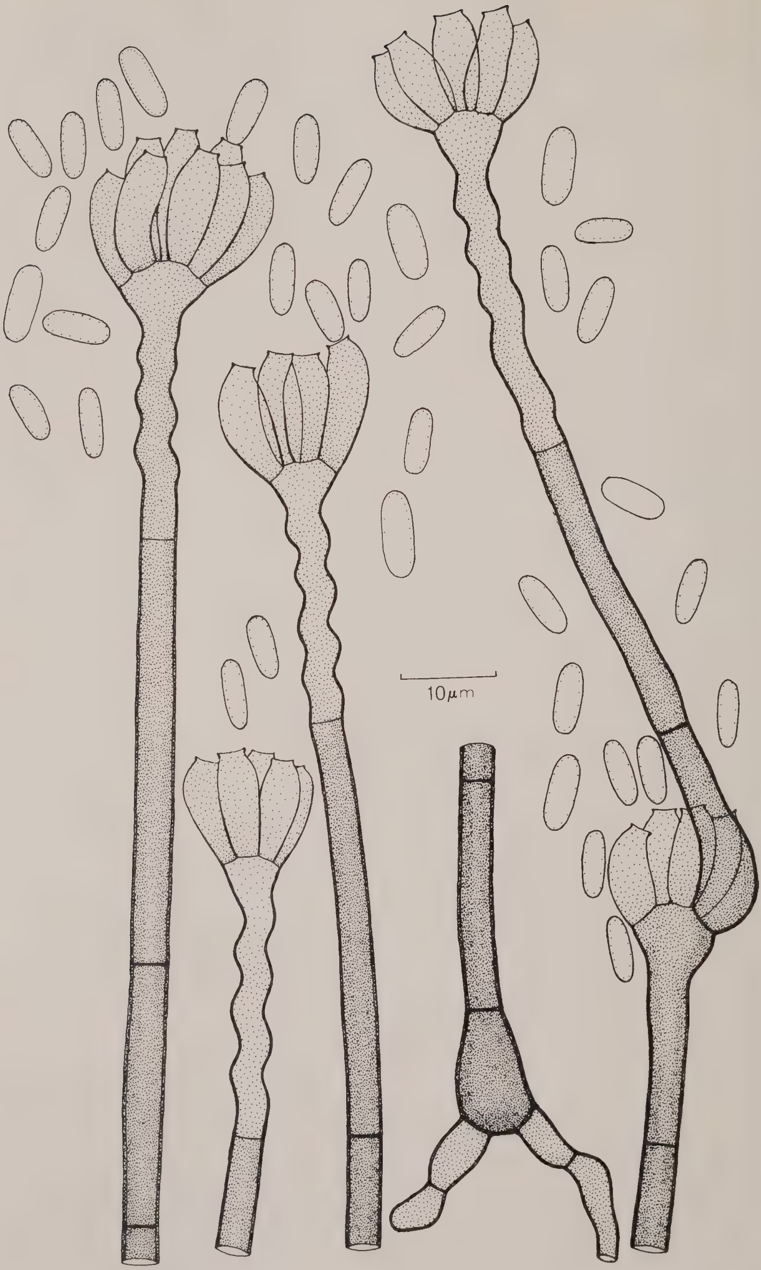

FIGURE 1. *Custingophora suidafrikana.*

aggregata, acropleurogena, simplicia, oblonga, hyalina, laevia, aseptata, 5 - 8 X 2 - 2.5μm.

In lignis putredinis, Debengeni Forest Reserve, N.E. Transvaal, South Africa, August 17, 1979, R.C. Sinclair, AUA, holotypus.

Colonies effuse, brownish gray to black. Mycelium mostly immersed in the substratum, composed of branched, septate, subhyaline to pale brown, smooth, 2 - 3μm wide hyphae. Conidiophores macronematous, monomenatous, erect, mostly straight, simple or rarely proliferating subapically, wavy towards the apex, smooth, brown, cylindrical but inflated at the extreme apex over the surface of which are borne a cluster of phialides; stipe up to 230μm long X 3 - 5μm wide. Conidiogenous cells monophialidic, discrete, determinate, smooth, pale brown, lageniform, straight or somewhat curved if at the periphery of a cluster, with a small terminal collarette, in groups at the swollen apex of the conidiophores, 7 - 9 X 2.5 - 3μm. Conidia enteroblastic, aggregated in heads, acropleurogenous, simple, oblong, obtuse at each end, hyaline, smooth, nonseptate, 5 - 8 X 2 - 2.5μm.

On rotten wood; South Africa.

Collection examined: on rotten, decorticated wood, Debengeni Forest Reserve, N.E. Transvaal, South Africa, August 17, 1979, R.C. Sinclair, AUA, holotype.

C. suidafrikana can be distinguished from *C. olivacea* in a number of respects. The morphology of the distal reaches of the conidiophore stipe, which is invariably wavy, is distinctive as are conidium dimensions; conidia of *C. olivacea* measure 2 - 3 X 1 - 1.5μm. The anamorph of *C. aspergilloides* differs similarly; the stipe is entirely straight and conidia are 10 - 12 X 5 - 7μm in size.

REFERENCES

Barr, M.E. and J.L. Crane. 1979. Another conidial state for a species of *Chaetosphaeria*. Can. J. Bot. 57: 835-837.

Stolk, A.C. and G.L. Hennebert. 1968. New species of *Thysanophora* and *Custingophora* gen. nov. Persoonia 5: 189-199.

ACKNOWLEDGEMENT

I thank Dr. J. Leland Crane, Illinois Institute of Natural Resources, for reviewing the manuscript.

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NOTES ON HYPHOMYCETES. XXXVII.
ARNOLDIOMYCES NOM. NOV.

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ABSTRACT

The generic name *Arnoldiomyces* Morgan-Jones is proposed to replace *Arnoldia* Gray and Morgan-Jones, the latter being a homonym of three previously established names.

NOMENCLATURAL PART

Gray and Morgan-Jones (1980) in proposing the generic name *Arnoldia* Gray and Morgan-Jones [type species *Arnoldia clavispora* Gray and Morgan-Jones] for a hyphomycetous mycoparasite growing on carpophores of *Coriolus versicolor* (Fr.) Quelet in Alabama, inadvertently created a later homonym of three earlier Arnoldias; *Arnoldia* Cassini 1824 (flowering plant), *Arnoldia* Blume 1826 (flowering plant), and *Arnoldia* Massalongo 1856 (lichen).

This faux pas necessitates the establishment of a new name for the fungus to replace the illegitimate *Arnoldia*.

Arnoldiomyces nom. nov.
= *Arnoldia* Gray and Morgan-Jones, Mycotaxon 10:375, 1980.
[non *Arnoldia* Cassini, Dict. Sc. Nat. 30: 330, 1824, *Arnoldia* Blume, Bijdr. 868, 1826; *Arnoldia* Massalongo Flora 39: 214, 1856]

Species typica: *Arnoldiomyces clavisporus* (Gray and Morgan-Jones) comb. nov.
≡*Arnoldia clavispora* Gray and Morgan-Jones, Mycotaxon 10: 376, 1980.

ACKNOWLEDGEMENT

I thank Dr. Clark T. Rogerson, The New York Botanical Garden, for bringing the illegitimate status of *Arnoldia* Gray and Morgan-Jones to my attention and for reviewing this note.

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NEW TAXA OF CORTICIACEAE FROM N. IRAN (BASIDIOMYCETES)

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ABSTRACT: Eight species and two formae are described as new. They belong to the genera *Cystostereum*, *Galzinia*, *Hyphodontia*, *Oliveonia*, *Peniophora*, *Phlebia*, *Sistotrema* and *Trechispora*. *Conferticium* (a segregate from *Gloeocystidiellum*) is described as a new genus with *C. insidiosum* as its type species. Deviating specimens from *Athelia*, *Mycoacia* and *Sistotrema* are discussed.

INTRODUCTION. During the spring of 1978, I carried out field research on wood-fungi in the Caspian forests of N. Iran. The present work is a continuation of earlier collections made in 1976 (Hallenberg 1978, 1980). Two localities were now thoroughly investigated:

1. The national park in Golestan forest, 150 km N.E. of Gorgan. Virgin forests with mainly *Parrotia* — along the rivers —, *Quercus* and *Crataegus*. The E. part of the national park is a bush steppe. 1978-04-26—05-08.

2. Sang-deh, S. of Pol-e-Sefid (Mazanderan). The collections were made in the *Fagus orientalis* zone, 1300—1800 m.s.m. 1978-05-10—13.

The wood-fungus flora of respective locality will be treated in later papers. In the present study, new taxa from this collection are presented, 8 *novae species*, 2 *formae* and 1 *genus*. Three deviating specimens are also discussed.

The collected material has been deposited in the herbaria GB and IRAN. The author's collection numbers are indicated with (NH).

Conferticium Hallenb. n. gen.

Fructificatio effusa, resupinata, ceracea, in sicco crustacea, saepe rimosa, cremea vel ochracea, stratosa, hymenio levi vel tuberculato; systema hyphale monomiticum, hyphis effibulatis, ± crassitunicatis, parietibus cyanophilis; subiculum tenue; hyphae subhymeniales verticales, dense confertae; cystidia tenuitunicata, cylindracea, sinuosa, saepe materiam granulosam, sulfo-positivam continentia; basidia clavata, 4 sterigmatibus, denso vallo conferta, interdum intus repetita; sporae subcylindraceae, ellipsoides, 4—8 µm longae, leves vel minute tuberculatae.

ETYMOLOGY: *confertus* = pressed close together, and *(Cort-)icium*.

TYPE SPECIES: *Gloeocystidium insidiosum* Bourdot & Galzin, Bull. Soc. mycol. Fr. 28:370, 1913. — *Gloeocystidiellum insidiosum* (Bourd. & Galz.) Donk, Fungus 26:9, 1956.

ADDITIONAL SPECIES: *Conferticium karstenii* (Bourd. & Galz.) Hallenb. n. comb. — *Gloeocystidium karstenii* Bourdot & Galzin, Hym. de Fr. p 254, 1928. — *Gloeocystidiellum karstenii* (Bourd. & Galz) Donk, Fungus 26:9, 1956.

Conferticium ochraceum (Fr.) Hallenb. n. comb. — *Thelephora ochracea* Fr., Syst. mycol. 1:446, 1821. — *Gloeocystidiellum ochraceum* (Fr.) Donk, Fungus 26:9, 1956.

Fructification effused, ceraceous, hard-crustaceous when dry, often cracking, stratified; hymenophore smooth, tuberculate, cream-coloured — ochraceous; hyphal system monomitic; hyphae without clamps, moderately thick-walled, subiculum thin, context hyphae vertically directed, densely united into a pseudoparenchymateous tissue, hyphal walls cyanophilous; cystidia thin-walled, tubular, sinuouse, with a granular content, mostly reacting positively to sulfo-vanilline; basidia clavate, with 4 sterigmata, without basal clamp, in a dense pallisade, occasional internal basidial repetition; spores subcylindrical, ellipsoid, spore wall smooth or finely warted, amyloid.

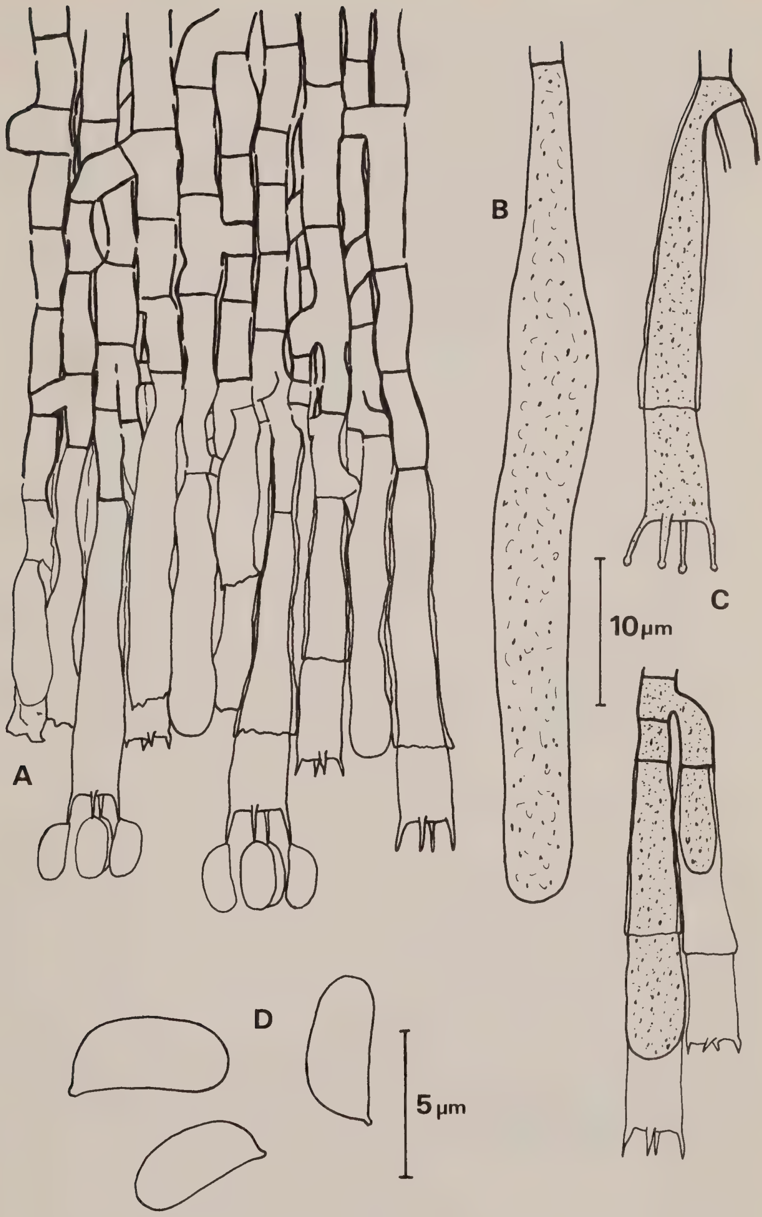
REMARKS: This genus is a segregate from *Gloeocystidiellum* Donk. Uniting characters are amyloid spores and presence of gloeocystidia, which mostly react positive to sulfo-vanilline. *Conferticium* differs by the hard context, consisting of vertically growing, cyanophilous, simple-septated, moderately thick-walled hyphae. Internal basidial repetition also occurs.

DESCRIPTION OF THE IRANIAN SPECIMENS OF *Conferticium insidiosum* (Bourd. & Galz.) Hallenb. (see fig. 1).

FRUCTIFICATION resupinate, effused, adnate, hard-crustaceous when dry, stratified, 50—500 µm thick; hymenophore smooth — tuberculate, sometimes cracked, cream-coloured — light ochraceous; margin more or less abrupt.

HYPHAL SYSTEM monomitic; hyphae without clamps, moderately thick-walled, 2—3 µm wide (according to Bourdot & Galzin, 1927, 2—4.5 µm), densely united; hyphal direction vertical; subiculum inconspicuous or absent; hyphal walls stained by cottonblue; scattered crystal aggregates in the context.

Fig. 1. *Conferticium insidiosum* A) section through fructification B) cystidium C) basidia D) spores. — Coll. N. Hallenberg 2277.


A
B
C
10 µm
D
5 µm

CYSTIDIA tubular, sinuose, thin — thick-walled, 30—70X3.5—5 µm, embedded, often growing through the whole fructification; content granular with positive reaction to sulfovanilline.

BASIDIA clavate, thin-walled, 22—30X3.8—4 µm, with 4 sterigmata and without basal clamp. Internal basidial repetition occasional. In the sporulating basidial layer the cell walls are strongly cyanophilous and in some collections also dextrinoid.

SPORES subcylindrical — ellipsoid, adaxial side straight or a little concave, smooth, thin-walled, 4—5X2—2.5 µm, with light-refracting content when observed with a phase-contrast microscope, walls amyloid.

HABITAT AND DISTRIBUTION: On fallen logs and trunks of deciduous trees. Golestan forest (NH 2277, 2278, 2279, 2280, 2281, 2282, 2299).

Cystostereum heteromorphum Hallenb. n. sp. (See fig. 2, 3)

Fructificatio resupinata, effusa, ceracea — membranacea, pallide ochracea, hymenophoro aculeis dispersis, aggregatis instructo, partim levi; subiculum arachnoide; margine angusto, arachnoide — fibrilloso; systema hyphale dimiticum; hyphae generatoriae fibulatae, 2—4 µm latae, hyphae sceleticae effibulatae, crassitunicatae, non cyanophilae, 1—2 µm latae; gloeocystidia cylindracea vel moniliformia, materiam flavidam, oleosam vel resinosam continentia, in hymenio et subiculo dispersa; corpora conidiis similia, 4—6X2—3 µm, a gloeocystidiis et hyphis subicularibus seiuncta; basidia clavata, 11—15X3.5—5 µm, 4 sterigmatibus; sporae subcylindraceae — ellipsoides, leves, tenuitunicatae, non-amyloides, 4—4.5X2—2.5 µm.

ETYMOLOGY: *heteromorphum* = different shape (of the hymenophore).

HOLOTYPUS: U.S.S.R., Carpatorossia, Jalinka prope Kosovská Polana/ad ligna/ 1930—07/ A. Pilát 2474.

FRUCTIFICATION resupinate, effused; hymenium ceraceous — membranaceous, light ochraceous; subiculum cobwebby, whitish, unevenly distributed, up to 1/2 mm thick; hymenophore partly odontioid with scattered, aggregated aculei, partly smooth, when dry, somewhat cracked; margin rather narrow, cobwebby or fibrillose.

HYPHAL SYSTEM dimitic; generative hyphae with clamps, thin- to moderately thick-walled, 2—4 µm wide, narrowing to 1.5 µm in diam. and then gradually turning into skeletal hyphae; these are sparsely branched, with false septa, thick-walled, often only with a narrow lumen, 1—2 µm wide, the walls are not stained by cottenblue or Melzer´s reagent. Subiculum mostly of skeletal hyphae along with generative hyphae, that produce gloeocystidia. In the subhymenium richly branched, thin-walled, generative hyphae, present.

GLOEOCYSTIDIA with an oily or resinous content, sulfonegative, thin- to moderately thick-walled, occurring both in the subiculum and the hymenium. In the hymenium they are more or less cylindrical, 12—40X5—8 µm; in the subiculum

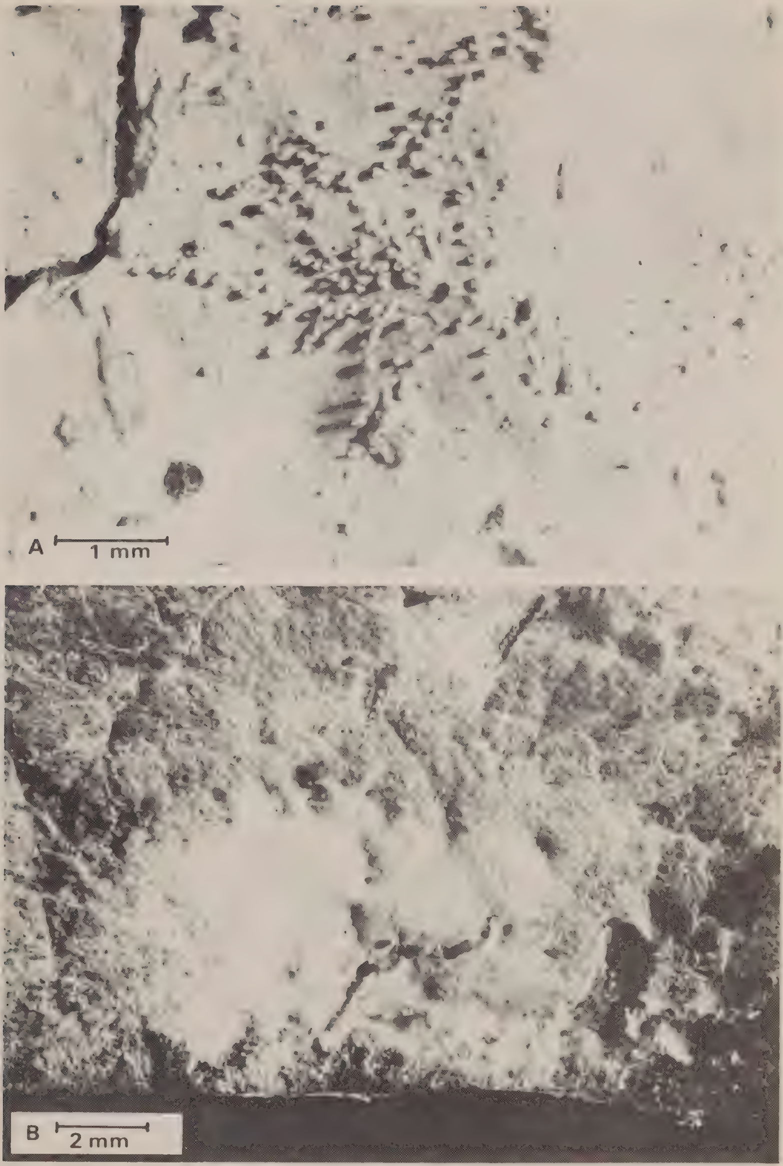


Fig. 2. *Cystostereum heteromorphum* A) Coll. A. Pilát 2474 (holotypus) B) Coll. N. Hallenberg 2712. Photo T. Hallingbäck.

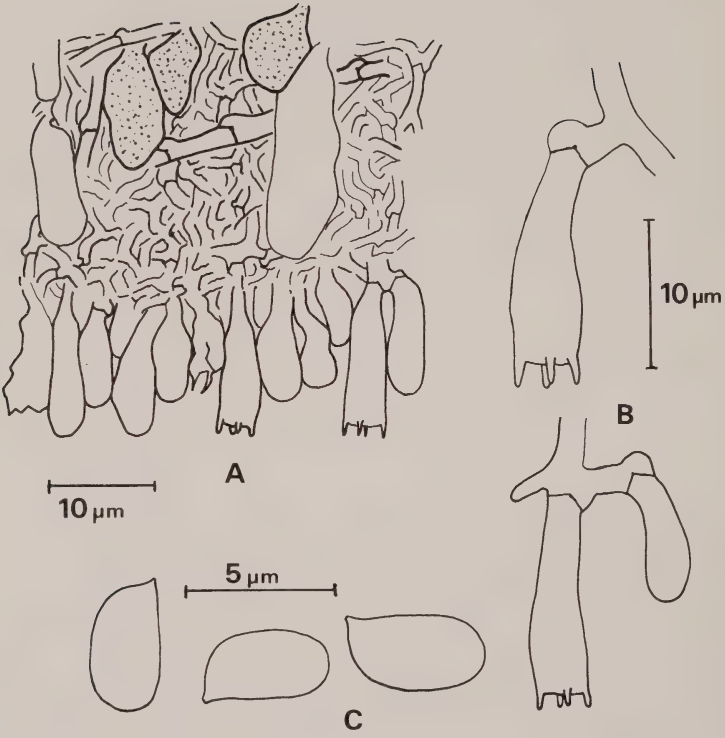
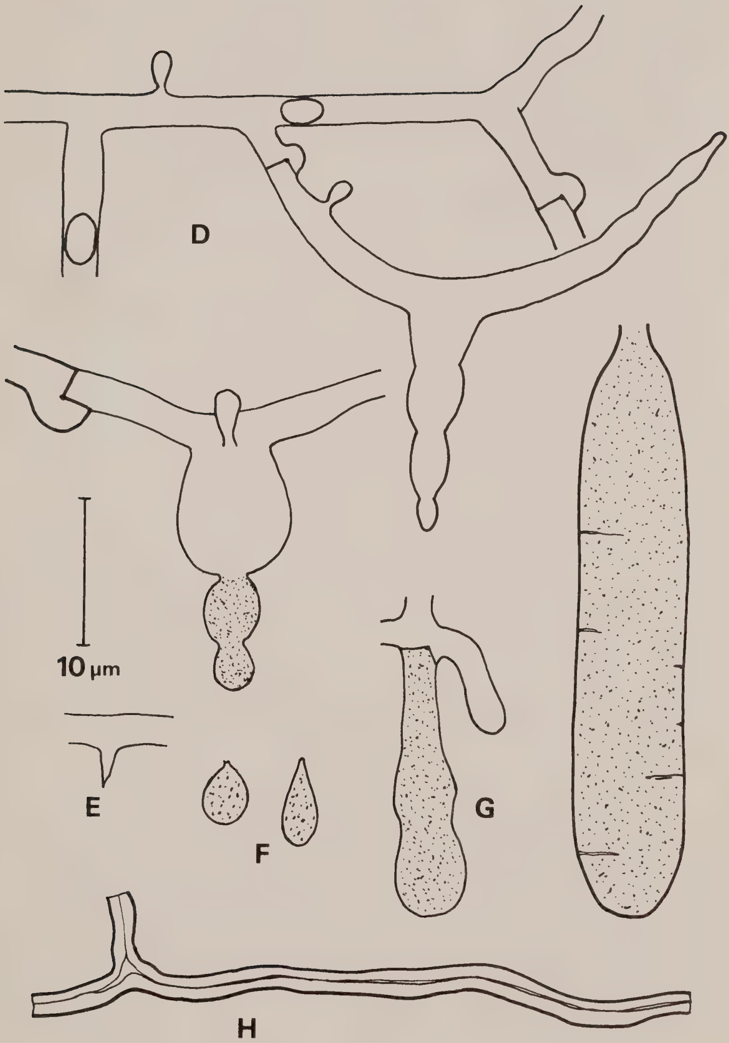


Fig. 3. *Cystostereum heteromorphum* A) hymenial details B) basidia C) spores D) generative hyphae in the subiculum producing gloeocystidia and conidium-like structures E) hypha with "conidiophore" F) conidium-like structures G) gloeocystidia H) skeletal hypha. — Coll. A. Pilát 2474


D
10 µm
E
F
G
H

they have very plastic shapes, often laterally initiated on a hypha, and more or less moniliform. The constriction which unites the terminal swelling with the rest of the cystidium is often very narrow. This terminal swelling which may also become detached appearing then as a conidium-like structure, is always plasma-dense, deeply stained by cottonblue.

ADDITIONAL HYPHOID STRUCTURES: In addition to the gloeocystidia, small plasma-rich bladders, 4—6X2—3 µm, develop on the hyphae as well as on the gloeocystidia in the subiculum. They may become detached in a manner similar to the terminal swellings of the moniliform gloeocystidia. These structures are also conidium-like and are of the same size and shape as those described above.

BASIDIA clavate, 11—15X3.5—5 µm, with basal clamp and 4 sterigmata, 3—4 µm long.

SPORES subcylindrical — ellipsoid, smooth, thin-walled, 4—4.5X2—2.5 µm, often adhering together in groups of 2 or 4; spore wall not stained by Melzer´s reagent or cottonblue.

HABITAT AND DISTRIBUTION: Two collections from U.S.S.R. (Carpatorossia, Jalinka prope Kosovská Polana/ ad ligna/ 1930—07/ A. Pilát, 2474 (Type) and 685). One collection from Iran, Mazanderan, Sang-deh /on a fallen log of Fagus/ NH 2712.

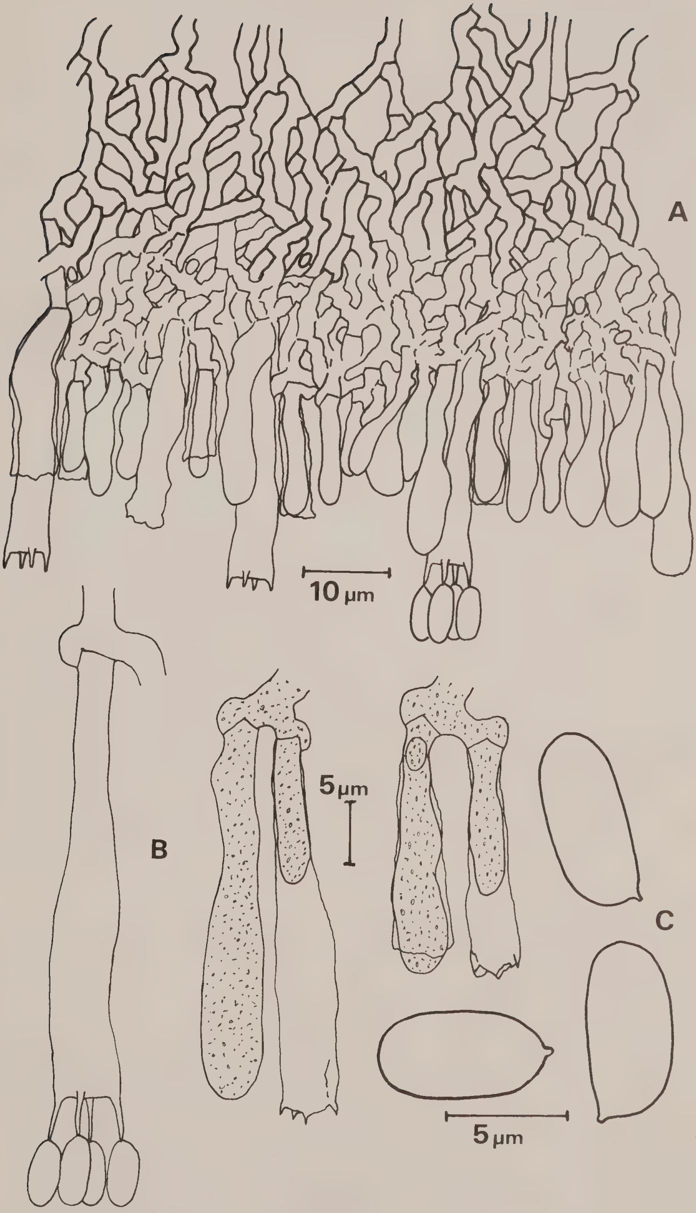
REMARKS: This species is a typical member of *Cystostereum*, when defined by gloeocystidia, with yellowish, oily or resinous content, presence of skeletal hyphae, clavate basidia and small, subcylindrical spores. In fact it comes close to *C. subabruptum* which mainly differs by having a different texture and presence of dendrohyphidia. While *C. subabruptum* has a crustaceous fructification, *C. heteromorphum* has a cobwebby subiculum and ceraceous subhymenium. In the early stages it is almost athelioid and smooth. The gloeocystidia in *C. subabruptum* may be provided with an apical bulb, thus resembling the more or less moniliform structures in *C. heteromorphum*.

Galzinia longibasidia Hallenb. n. sp. (see fig. 4)

Fructificatio resupinata, effusa, adnata, tenuis, ceracea, in sicco crustacea, pruinosa, hymenio levi, pallide ochraceo; systema hyphale monomiticum; hyphae fibulatae, 2—3 µm latae; basidia subclavata, sinuosa, saepe in medio constricta, 26—38X5—6.5 µm, materiam granulosam continentia, intus ± frequenter repetita; sporae subcylindraceae, leves, parietibus crassescentibus, 6—7X3—3.8 µm, non-amyloides.

ETYMOLOGY: *longibasidia*, the basidia are longer than in the closely related *Galzinia incrustans* (v. Höhn. & Litsch.) Parm.

Fig. 4. *Galzinia longibasidia* A) section through fructification B) basidia C) spores. — Coll. N. Hallenberg 2417.


A
10 µm
B
5 µm
C
5 µm

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On a fallen branch of a deciduous tree/ 1978—05—04/ NH 2417.

PARATYPUS: NH 2403, collection data as above.

FRUCTIFICATION effused, resupinate, adnate, thin, ceraceous, as dry pruinose and rather hard; hymenophore smooth, grey ochraceous; margin abrupt.

HYPHAL SYSTEM monomitic; hyphae with clamps, flexuose, richly branched, 2—3 µm wide, in subiculum moderately thick-walled, in subhymenium more thin-walled; walls not stained by cottonblue or Melzer´s reagent.

CYSTIDIA none.

BASIDIA subclavate, sinuose, sometimes stalked, often with a constriction in the middle, 26—38X5—6.5 µm, content granular, with 4 sterigmata and basal clamp.

Internal basidial repetition more or less frequent. Occasionally basidia deviate by developing abnormal sterigmata; few pleurobasidia seen.

SPORES subcylindrical, smooth, with thickened walls, not stained by cottonblue or Melzer´s reagent, 6—7X3—3.8 µm.

REMARKS: The sinuose basidia with internal repetition make *Galzinia* a good genus for this species, being easily separated from the other species in the genus by the relatively large, subcylindrical spores.

Hyphodontia quercina (Fr.) John Erikss. f. *coralloides* Hallenb. n. forma. (see fig. 5 B, C)

Formae typicae valde similis sed differt hymenophoris aculeis diffuse ramosis instructis.

HOLOTYPUS: Iran, Mazanderan, Sang-deh/ On a still-attached branch of *Fagus*/ 1978—05—11/ N. Hallenberg 2797.

FRUCTIFICATION with a raduloid hymenophore, where the individual aculei are branched several times in a coralloid manner. In other respects like *Hyphodontia quercina* f. *quercina*.

Oliveonia subfibrillosa Hallenb. n. sp. (see fig. 6)

Fructificatio resupinata, effusa, dense adnata, reticulata — fibrillosa, tenuis, pallida; margine indeterminato; systema hyphale monomiticum; hyphae fibulatae, 1—3 µm latae, tenuitunicatae; subiculum valde tenue; hyphae subiculares rectae vel irregulariter ramosae, gelatinosae; cystidia cylindracea, sinuosa, tenuitunicata, hyalina, 17—37X5—7 µm; basidia late clavata, interdum pedunculata, 10—12X5.5—6.5 µm, 4 sterigmatibus, 5—6.5 µm longis; sporae ellipsoides — suballantoides, tenuitunicatae, leves, 6—7X3—3.5 µm, non-amyloides, repetitione germinantes.

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On a fallen trunk of a deciduous tree/ 1978—04—30/ N. Hallenberg 2227.

FRUCTIFICATION resupinate, effused, closely adnate, finely reticulate — pruinose, thin, whitish grey; margin indistinct.

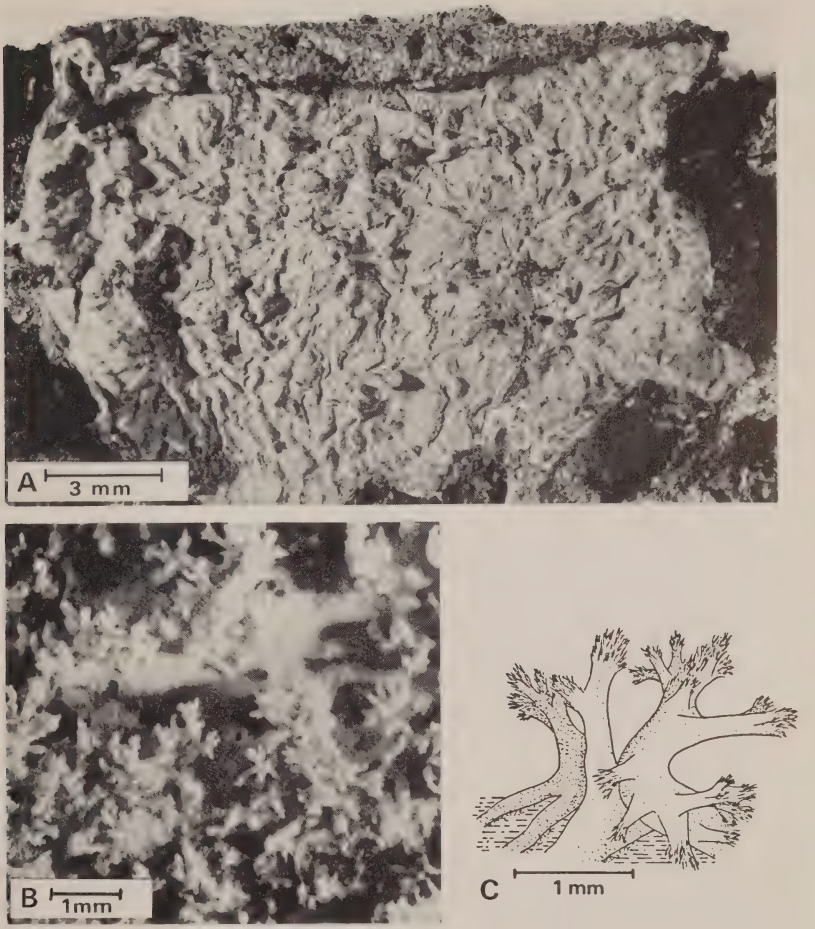


Fig. 5. A) *Peniophora quercina* f. *phlebioides* — Coll. NH 2015.
B, C) *Hyphodontia quercina* f. *coralloides* — Coll. NH 2797.

HYPHAL SYSTEM monomitic; hyphae with clamps, 1—3 µm wide, thin-walled, non-cyanophilous; subiculum very thin, composed of straight or irregularly branched hyphae, united in a gelatinous substance; from the subiculum hymenial branches develop vertically.

CYSTIDIA cylindrical, sinuose, 17—37X5—7 µm, sometimes with protuberances, thin-walled, hyaline.

BASIDIA broadly clavate, sometimes stalked, 10—12X5.5—6.5 µm, with 4 prominent sterigmata, 5—6.5 µm long, and basal clamp.

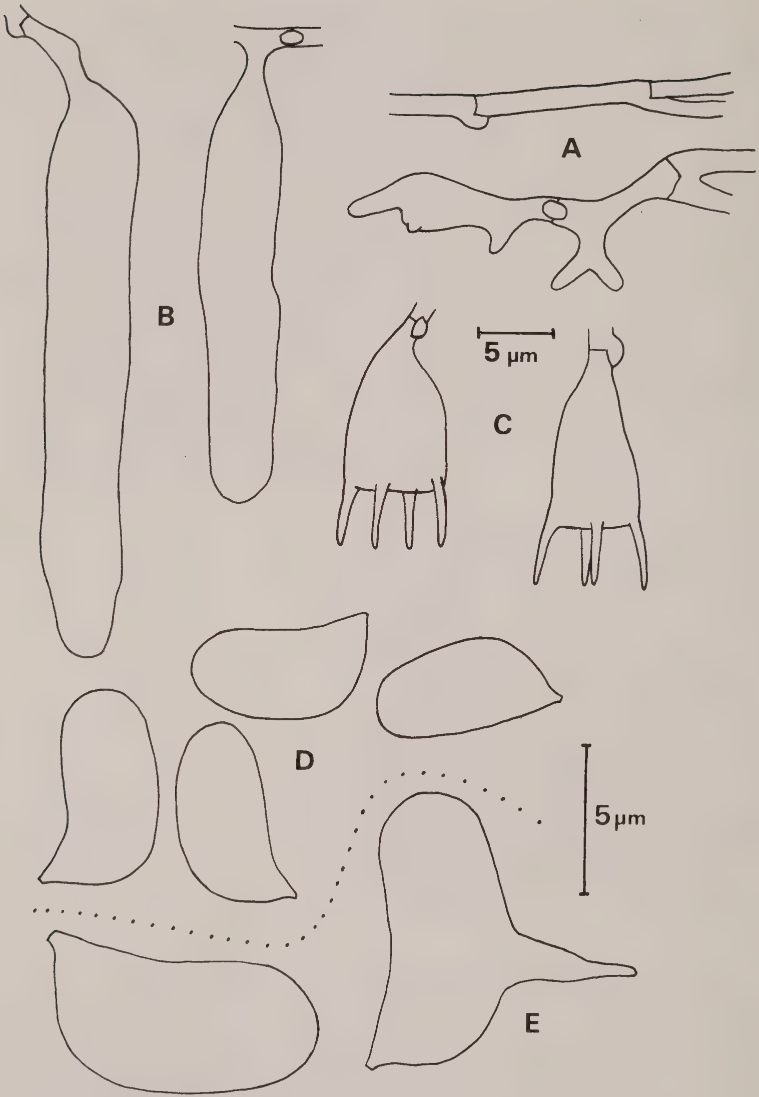


Fig. 6. *Oliveonia subfibrillosa* A) subicular hyphae B) cystidia C) basidia D) spores. — Coll. N. Hallenberg 2227. *O. fibrillosa* E) spores. — Coll. Murill 515 (holotypus).

SPORES ellipsoid — suballantoid, thin-walled, smooth, 6—7X3—3.5 µm, non-amyloid, germinating by repetition.

HABITAT AND DISTRIBUTION: On wood and fallen trunks of *Quercus*, *Fagus* and a deciduous tree. Golestan forest (NH 2222, 2227), Sang-deh (NH 2868).

REMARKS: This species is very close to *O. fibrillosa* (Burt) Donk and *O. pauxilla* (Jacks.) Donk. *O. fibrillosa* differs by larger spores 7—10X3—5 µm, cystidia 30—90X6—9 µm, and basidia about 10 µm wide (Martin 1948). *O. pauxilla* differs mainly by the absence of clamps.

Peniophora quercina (Fr.) Cke f. *phlebioides* Hallenb. n. forma (see fig. 5 A)

Formae typicae valde similis sed differt hymenophoris radiatim plicatis.

HOLOTYPUS: Iran, Gorgan, Golestan forest/On a fallen twig/ 1978—04—26/ N. Hallenberg 2015.

FRUCTIFICATION with a radiately folded hymenium. In other respects like *P. quercina* f. *quercina.*

Peniophora pseudonuda Hallenb. n. sp. (see fig. 7 A, 8)

Fructificatio effusa, resupinata, adnata, usque ad 0.2 mm crassa, hymenio murino — pallide subfusco, margine abrupto; systema hyphale monomiticum; hyphae fibulatae, 2—5 µm latae, parietibus crassescentibus, non cyanophilis; stratosa basale 15—75 µm, hyphis crassitunicatis, fulvis, substrato parallelis compositum; hyphae subhymeniales dense confertae, verticales; sulfocystidia clavata, cylindracea, 50—80X9—15 µm, parietibus crassescentibus, inclusa; cystidia incrustata anguste conica — cylindracea, crassitunicatae, 25—40X9—12 µm, inclusa; basidia clavata — cylindracea, 47—80X5—7 µm, 4 sterigmatibus; sporae cylindraceae — suballantoides, tenuitunicatae, leves, 9—11X3.5—4 µm, nonamyloides, uni-nucleatae.

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On a fallen branch of a deciduous tree 1978—05—06/ N. Hallenberg 2555.

FRUCTIFICATION effused, resupinate, adnate, up to 0.2 mm thick; hymenium light greyish brown, smooth; margin abrupt.

HYPHAL SYSTEM monomitic; hyphae with clamps, 2—5 µm wide, with thickened walls, non-cyanophilous; basal layer 15—75 µm thick, composed of brown-pigmented, thick-walled hyphae, densely united, running parallel to the substrate; subhymenial hyphae vertically directed, densely united, basal parts sometimes brown-pigmented.

CYSTIDIA of two kinds. Sulfocystidia clavate — cylindrical, sinuose, 50—80X9—15 µm, rather thick-walled, at least in the basal part, content granular, numerous, embedded but often reaching the hymenial surface. Encrusted cystidia narrowly conical, thick-walled, 25—40X9—12 µm, rather frequent, embedded.

BASIDIA clavate — tubular, sinuose, 47—80X5—7 µm, densely packed in a thickening hymenium, thin-walled but often with basally thickened walls, with 4 sterigmata and basal clamp.

SPORES cylindrical — suballantoid, thin-walled, smooth, 9—11X3.5—4 µm, non-amyloid, uni-nucleate.

HABITAT AND DISTRIBUTION: On branches and twigs of *Parrotia*, *Quercus*, *Fagus* and other deciduous trees. Golestan forest 5, Sang-deh 1 collection. Two collections, previously reported as *P. nuda* (Fr.) Bres. (Gorgan, NH 1296, 1549) belong to this taxon.

REMARKS: *P. pseudonuda* is very close to *P. nuda*. It differs by the presence of a well developed basal layer of densely united, parallel oriented, brown-pigmented hyphae and by the broader, less slender spores.

Interfertility tests between *P. pseudonuda* (NH 2555) and *P. pseudoversicolor* Boid (LY 2086, 4643), *P. nuda* (GB 24031, 24036, NH 3070), and *P. incarnata* (Fr.) Karst. (NH 2215, 2267) have been made and were all negative.

Phlebia caspica Hallenb. n. sp. (see fig. 7 B, C, 9)

Fructificatio resupinata, effusa, dense adnata, tenuis, in sicco crustacea, hymenio ± dense tuberculato, cremaceo — pallide ochraceo; systema hyphale monomiticum; hyphae fibulatae, in subiculo parallelae, 3—5 µm latae, in subhymenio dense confertae, verticales, 2—3 µm latae, non cyanophilae, parietibus tenuibus, distinctis; cystidia subulata, tenuitunicata, 40—67X4—4.5 µm; basidia clavata, 18—30X4—4.5 µm, 4 sterigmatibus; sporae ellipsoides, leves, tenuitunicatae, 4—5X 2—2.5 µm, non-amyloides.

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On a fallen branch of a deciduous tree/ 1978—04—29/ N. Hallenberg 2189.

FRUCTIFICATION resupinate, effused, closely adnate, thin, crustaceous when dry; hymenium rather densely tuberculate, cream-coloured — light ochraceous; margin thin, white, minutely fibrillose or indeterminate.

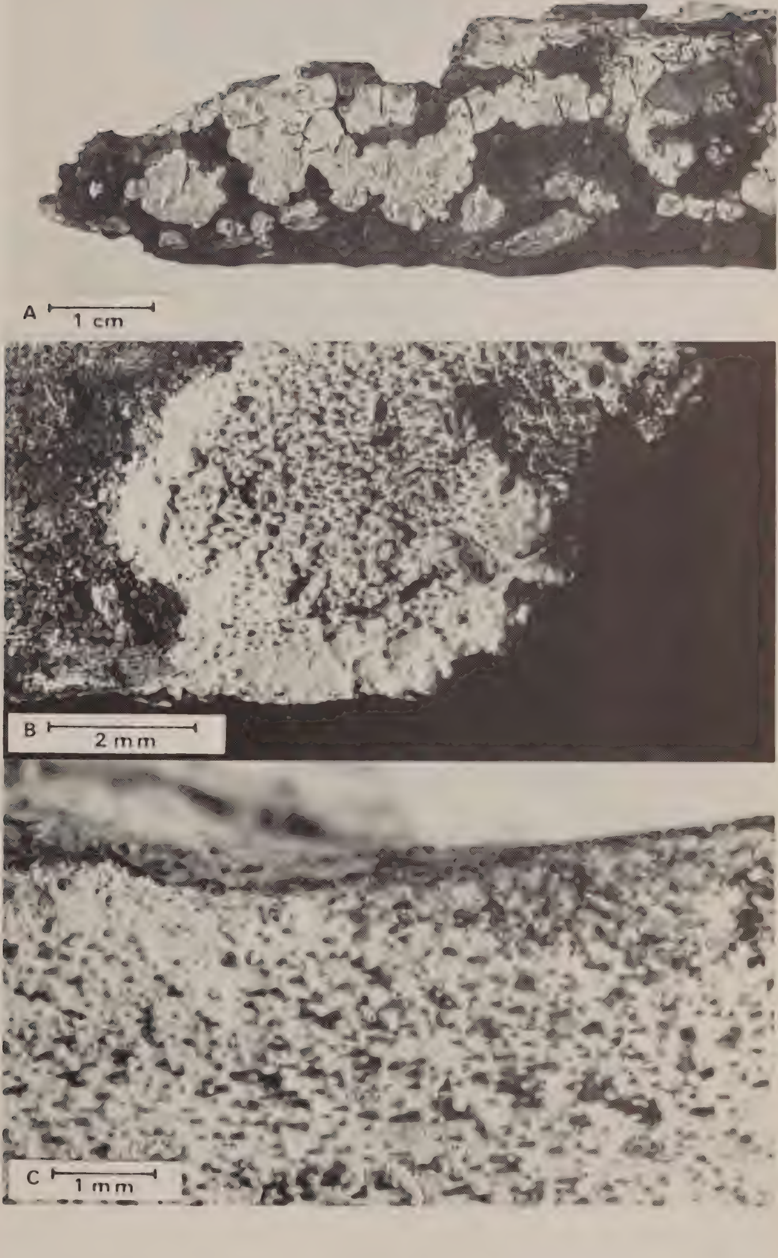
HYPHAL SYSTEM monomitic; hyphae with clamps, walls thin but distinct; in the subhymenium running vertically, richly branched, densely packed, 2—3 µm wide; in the subiculum more or less parallel to the substrate, 3—5 µm wide; walls not cyanophilous.

CYSTIDIA subulate, thin-walled, hyaline, 40—67X4—4.5 µm, distributed through the hymenium but most common at apices of aculei.

BASIDIA clavate, 18—30X4—4.5 µm, with 4 straight sterigmata and basal clamp.

SPORES ellipsoid, adaxial side flattened or a little concave, smooth, thin-walled, 4—5X2—2.5 µm, non-amyloid.

Fig. 7. A) *Peniophora pseudonuda* — Coll. N. Hallenberg 2557 B) *Phlebia caspica* — Coll. NH 2189 C) ditto — Coll. NH 2628 A. Photo T. Hallingbäck.


A
1 cm
B
2 mm
C
1 mm

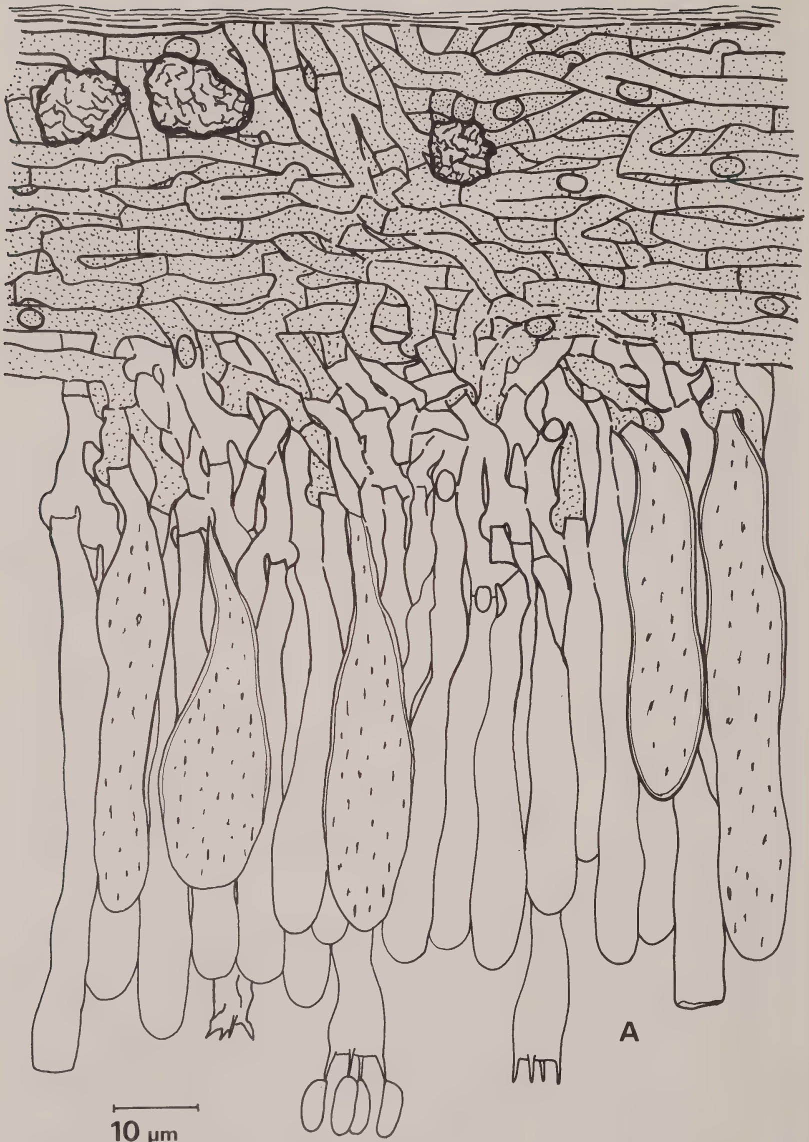
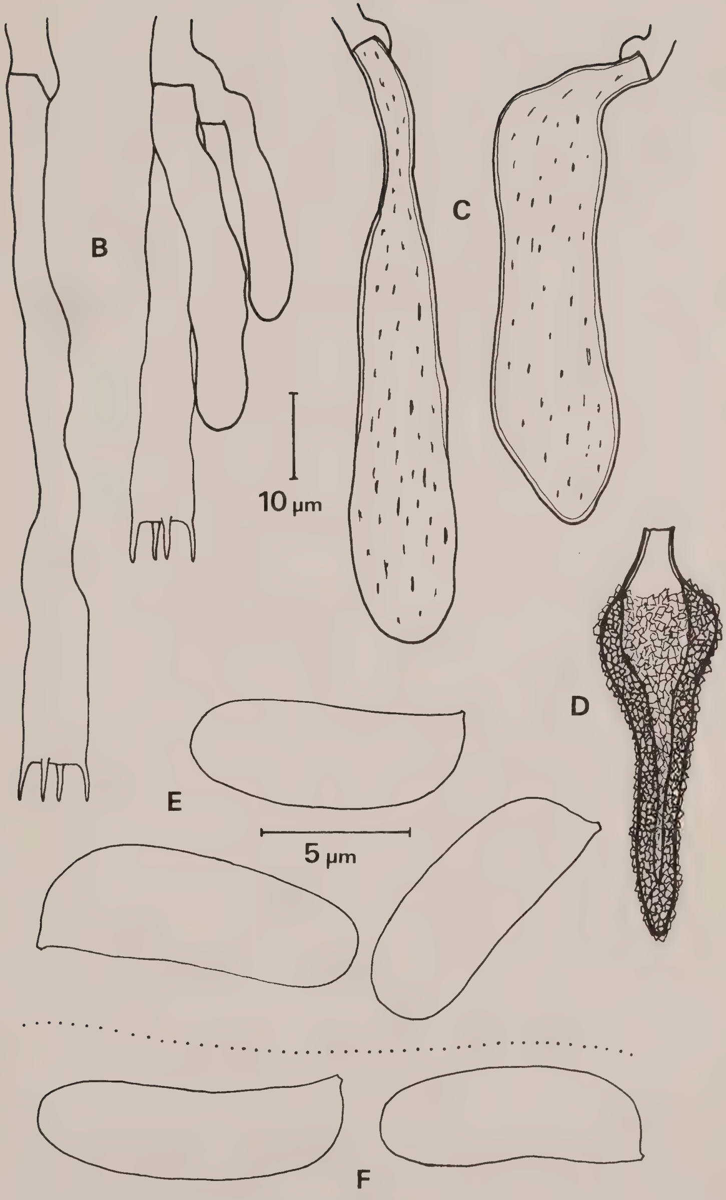


Fig. 8. *Peniophora pseudonuda* A) section through fructification B) basidia C) gloeocystidia D) encrusted cystidium E) spores. — Coll. N. Hallenberg 2555. *P. nuda* F) spores. — GB 24031.


B
C
10 µm
D
E
5 µm
F

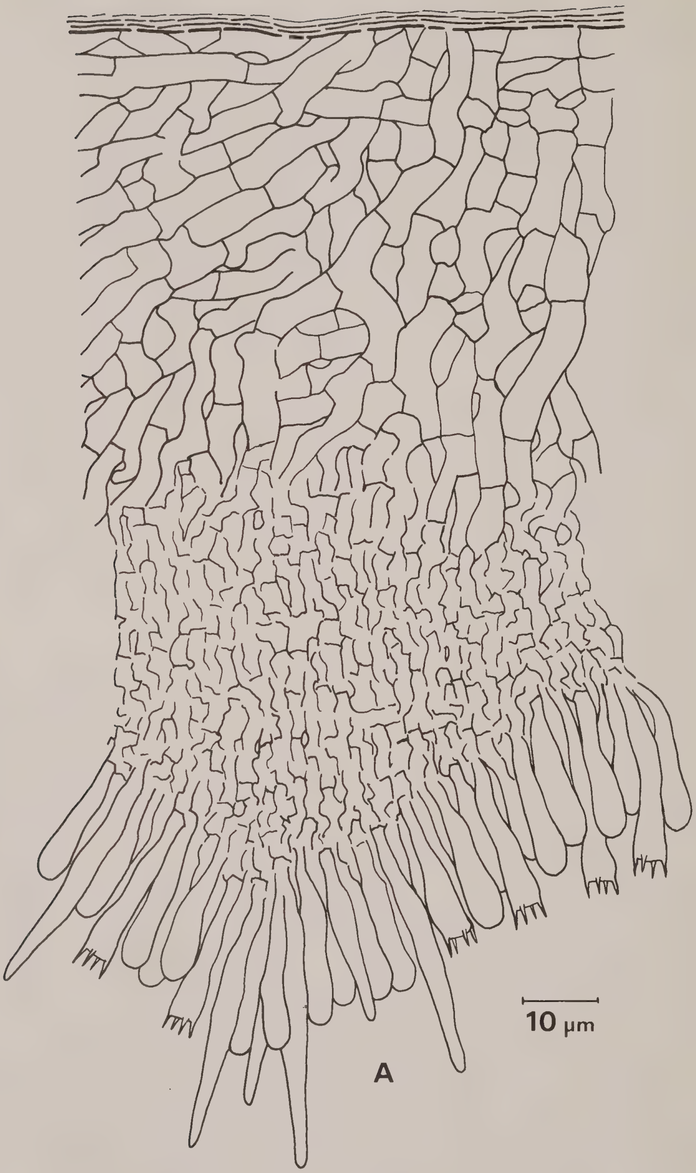
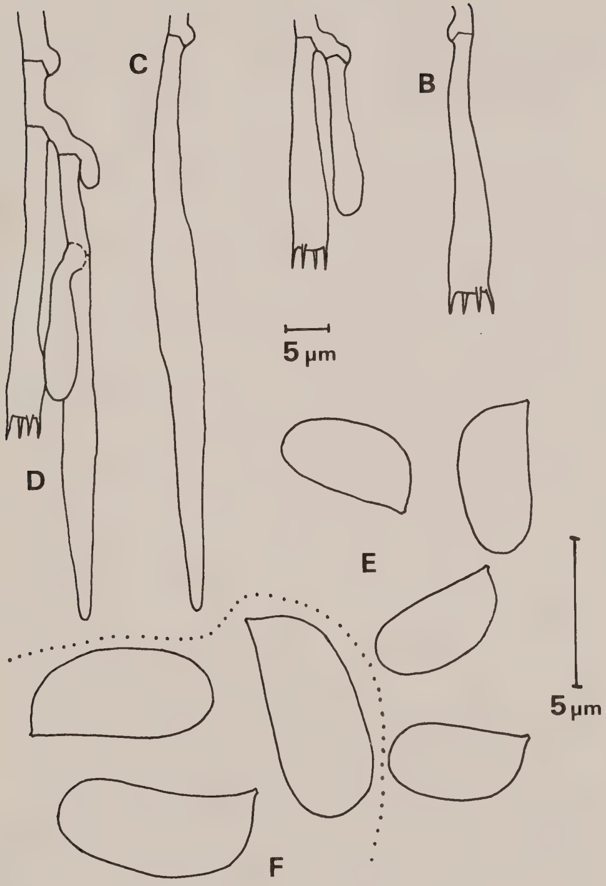


Fig. 9. *Phlebia caspica* A) section through fructification B) Basidia C) cystidium D) hymenial detail with basidium and cystidium E) spores. — Coll. N. Hallenberg 2189. *P. subochracea* F) spores. — Coll. N. Hallenberg 2152.


C
B
5 µm
D
E
5 µm
F

HABITAT AND DISTRIBUTION: On fallen branches and on a fallen trunk of *Fagus orientalis* and another deciduous tree. Golestan forest (NH 2189). Sang-deh (NH 2628 A, 2673, 2849, 2855, 2880).

REMARKS: This species is very close to *P. subochracea* (Bres.) Erikss. & Ryv. However, the fructification of *P. subochracea* is more or less reddish when dry and the aculei are more sparsely and unevenly distributed. Moreover, the spores of the latter species are larger (6—8X2.5—3.5 µm, Erikss., Hjortst., Ryv. 1980).

Sistotrema resinicystidium Hallenb. n. sp. (see fig. 10)

Fructificatio resupinata, effusa, dense adnate, tenuis, hypochnoides, minute tuberculata, hymenio albescenti — pallide ochraceo; systema hyphale monomiticum, hyphae fibulatae, 2—4.5 um latae, parietibus tenuibus, distinctis, in subiculo laxe intertextae, partim materiam flavidam, resinosam continentes; cystidia submoniliformia, sinuosa, 20—40X4.5—8 µm, materiam flavidam, resinosam continentia, ± inclusa; basidia urniformia, 17—30X4—5 µm, basali parte usque ad 6 µm lata, 4—8 sterigmatibus; sporae ellipsoides, leves, tenuitunicatae, 4—4.5X 2—2.8 µm, non-amyloides.

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On brown-rotted wood of *Quercus* on the ground/ 1978—04—27/ N. Hallenberg 2105.

FRUCTIFICATION resupinate, effused, closely adnate, thin, hypochnoid, minutely tuberculate; hymenium whitish — light ochraceous; margin indistinct.

HYPHAL SYSTEM monomitic; hyphae with clamps, 2—4.5 µm wide, with thin but distinct walls; in subiculum very loosely interwoven; partly with a yellowish, resinous content; lots of crystalline material in the context.

CYSTIDIA submoniliform, sinuose, 20—40X4.5—8 µm, with a yellowish, resinous content, turning dark brown in sulfo-vanilline, embedded or slightly projecting, often connected with the resin-filled, subicular hyphae.

BASIDIA urniform, 17—30X4—5 µm, basal part up to 6 µm wide, with 4—8 sterigmata and basal clamp.

SPORES ellipsoid, adaxial side flattened or a little convex, smooth, thin-walled, 4—5.5X2—2.8 µm, non-amyloid.

HABITAT AND DISTRIBUTION: On brown-rotted wood of *Quercus*. Golestan forest (NH 2104, 2105, 2466).

REMARKS: *S. resinicystidium* is easily distinguished from the other species in *Sistotrema*, due to the peculiar cystidia and the resinfilled subicular hyphae. Nevertheless, it finds a natural position in the vicinity of *S. coroniferum* (v. Höhn. & Litsch.) Donk.

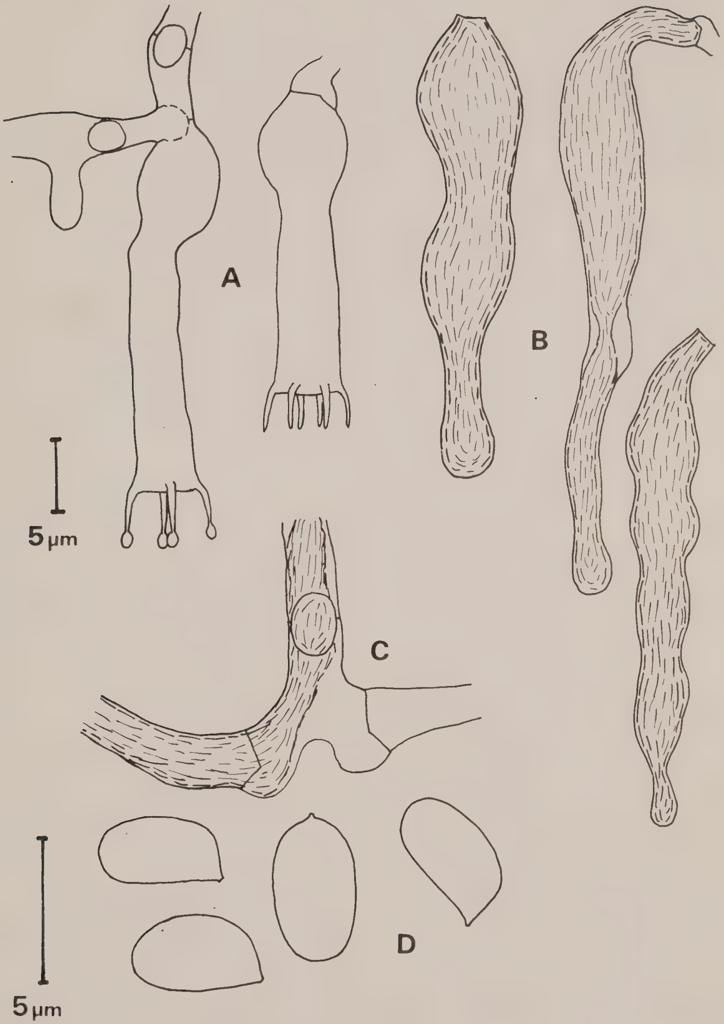

A
B
C
D
5 µm
5 µm

Fig. 10. *Sistotrema resinicystidium* A) basidia B) cystidia C) subicular hyphae D) spores. — N. Hallenberg 2105.

Sistotrema suballantosporum Hallenb. n. sp. (see fig. 11)

Fructificatio resupinata, effusa, pellicularis, tenuis, hymenio levi, cremeo — pallide ochraceo, margine albescenti, arachnoide; systema hyphale monomiticum; hyphae fibulatae, in subiculo laxe intertextae, 3.5—5.5 µm latae, parietibus crassescentibus, fibulis ampullatis, interdum in modum striarum conjuncta, in subhymenio tenuitunicatae, 2.5—4 µm latae, materiam oleosam continentes; basidia urniformia, 14—30X 4.5—5.5 µm, basali parte 5.5—6.5 µm lata, 4—8 sterigmatibus; sporae suballantoides — subfusoides, leves, tenuitunicatae, 7—9X2—2.5 µm, non-amyloides.

HOLOTYPUS Iran, Gorgan, Golestan forest/ On decayed wood on the ground/ 1978—04—26/ N. Hallenberg 2019.

FRUCTIFICATION resupinate, effused, pellicular, thin; hymenium smooth, cream-coloured — light ochraceous; margin whitish, cobwebby.

HYPHAL SYSTEM monomitic; hyphae with clamps; subicular hyphae rather thick-walled, 3.5—5.5 µm wide, with ampullate clamps, sparsely branched, loosely interwoven, sometimes united in strands running parallel to the substrate; subhymenial hyphae thin-walled, 2.5—4 µm wide, with abundant oil drops; hymenium athelioid.

BASIDIA urniform, 14—30X4.5—5.5 µm, basal part 5.5—6.5 µm wide, with 4—8 sterigmata and basal clamp.

SPORES suballantoid—subfusoid, smooth, thin-walled, 7—9X 2—2.5 µm, non-amyloid.

REMARKS: *S. suballantosporum* is well distinguished from the other species in the genus by the pellicular fructification and the narrow, suballantoid spores.

Trechispora dimitica Hallenb. n. sp. (see fig. 12)

Fructificatio resupinata, effusa, laxe adnata, hypochnoides, valde fragilis, rhizomorphae adsunt; systema hyphale dimiticum; hyphae sceleticae effibulatae, 2—2.5 µm latae, crassitunicatae, cyanophilae; hyphae generatoriae 1.3—2 µm latae, tenuitunicatae, in rhizomorphis fibulis ampullatis instructae, in subhymenio fibulis usitatis; in contextu crystalla acicularia, permulta, forma ad instar stellarum aggregata; aleuriosporae frequentes, subglobosae, tenuitunicatae, leves, 4—5X3.5—4.5 µm, fibula basali instructae, in ramis hyphalibus, angustis, 0.8—1 µm latis, procreatae; basidia breviter cylindracea, 9—13X3.5—4 µm, 4 sterigmatibus, basibus interdum biradicatis (pleurobasidia); sporae ellipsoides, asperulatae, adaxiali parte saepe levi, tenuitunicatae, 3—4X2.3—2.5 µm, non-amyloides.

HOLOTYPUS: Iran, Gorgan, Golestan forest/ On a fallen branch/ 1978-05-01/ N. Hallenberg 2328.

FRUCTIFICATION resupinate, effused, loosely adnate, very brittle; hymenium whitish, farinose, discontinous; subiculum loosely cobwebby; rhizomorphs present; margin indistinct.

HYPHAL SYSTEM dimitic; skeletal hyphae with false septa, 2—2.5 µm wide, thick-walled, forming the major part of the rhizomorphs, sometimes connected with a thin-walled hypha by a clamp, walls stained by cottonblue; generative hyphae with clamps, thin-walled, 1.3—2 um wide, in rhizomorph hyphae with ampullate

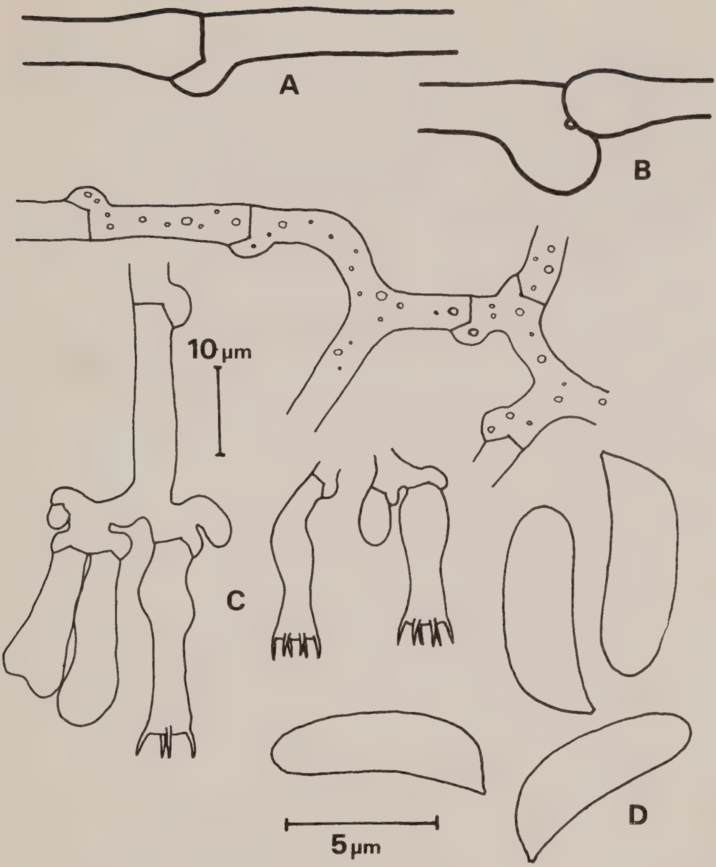


Fig. 11. *Sistotrema suballantosporum* A) subicular hyphae B) subhymenial hyphae C) hymenial details with basidia D) spores. — Coll. N. Hallenberg 2019.

clamps, subhymenial hyphae with ordinary clamps. Numerous needle-shaped crystals in the context grouped in star-like structures.

ALEURIOSPORES frequent in the context, smooth, thin-walled, subglobose, 4—5X3.5—4.5 µm with basal clamp, produced on narrow hyphal branches, 0.8—1 µm wide.

BASIDIA short-cylindrical, 9—13X3.5—4 µm, with 4 sterigmata and basal clamp, mostly developed on hyphal strands, sometimes pleurobasidia formed.

SPORES ellipsoid, asperulate, except for the adaxial side which is often smooth, thin-walled, 3—4X2.3—2.5 µm, non-amyloid.

REMARKS: This species is easily characterized by the dimitical hyphal system, the frequent aleuriospores and the star-like crystal structures in the context. Hitherto only one dimitic species in *Trechispora* has been found viz. *T. pallido-aurantiaca* Gilberts. & Bud. which, however, differs by coloured context hyphae, presence of hyphoid cystidia, absence of aleuriospores, and basidiospores of a different shape (Liberta 1973).

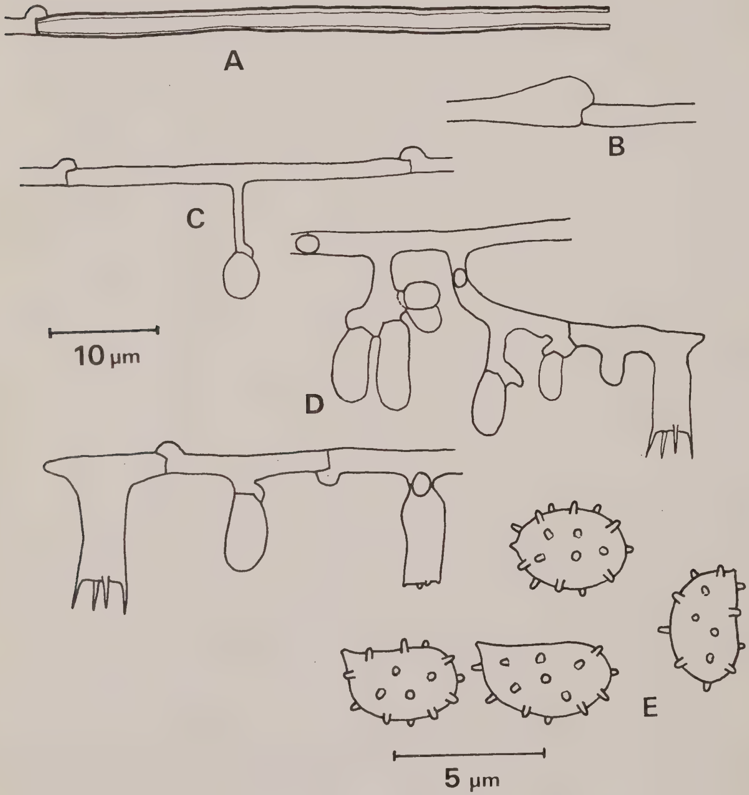


Fig. 12. *Trechispora dimitica* A) skeletal hypha B) generative hypha with ampullate clamp C) aleuriospore-formation D) hymenial details with basidia E) spores. — Coll. N. Hallenberg 2328

Athelia sp. (see fig. 13)

SPECIMEN: Iran, Gorgan, Golestan forest/ On a fallen branch of a deciduous tree/ 1978—05—08/ N. Hallenberg 2588.

FRUCTIFICATION resupinate, effused, thin, pellicular, whitish.

HYPHAL SYSTEM monomitic; basal hyphae thin- to moderately thick-walled, 2.5—4.5 µm wide, with scattered clamps, walls cyanophilous; subhymenial hyphae thin-walled, 2.5—3.5 µm wide, without clamps.

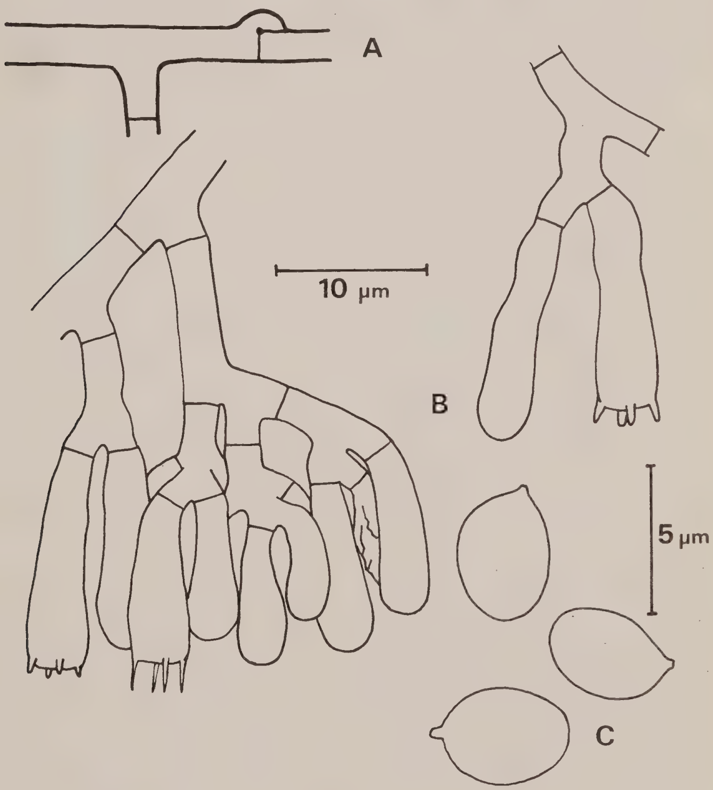


Fig. 13. *Athelia* sp. A) basal hypha B) hymenial details with basidia C) spores — Coll. N. Hallenberg 2588.

CYSTIDIA none.

BASIDIA 12—18X4—5 µm, with 4 sterigmata, 3—4 µm long, and without basal clamp.

SPORES broadly ellipsoid, thin-walled, smooth, non-amyloid, 4—5X3—3.5 µm.

REMARKS: This specimen belongs to the *A. epiphylla*-complex but differs by the broadly ellipsoid spores and the smaller basidia. *A. subsphaerospora* Jül. in herb. (see also Eriksson & Ryvarden, 1973, p. 131) comes very close but differs by somewhat narrower basidia and slightly smaller spores. Taxonomic conclusions about these specimens, with broadly ellipsoid — subglobose spores, must wait until more material is available. Also, interfertility tests would be of greatest importance in solving the difficult delimitation problems within the whole complex.

Mycoacia sp. (see fig. 14)

SPECIMEN: Iran, Gorgan, Golestan forest/ On a fallen branch/ 1978—04—29/ N. Hallenberg 2139.

FRUCTIFICATION resupinate, effused, adnate, rather thin, membranaceous — crustaceous, odontioid, aculei slender, ab. 0.2 mm long, with penicillate apices, cream-coloured; margin indistinct.

HYPHAL SYSTEM monomitic; hyphae with clamps; in context rather thick-walled, 1.5—2 µm wide; in subhymenium thin-walled, richly branched, densely united, 2—4 µm wide, non-cyanophilous.

PSEUDOCYSTIDIA irregularly widened hyphal endings, subsequently heavily encrusted, thin — moderately thick-walled, 50—75X5.5—7.5 µm, sulfo-negative. They are frequently found in centres and apices of aculei.

BASIDIA clavate, 13—25X4.5—6 µm, with 4 sterigmata and basal clamp.

SPORES subglobose — broadly ellipsoid, thin-walled, smooth, 3.5—4X2.5—3 µm, non-amyloid.

REMARKS; This species is not a typical member of *Mycoacia*. It differs mainly by the shorter aculei and in the shape of the spores. *Sarcodontia* is another possibility, but the only species, *S. crocea* (Fr.) Kotl., differs by the lack of encrusted pseudocystidia, much larger teeth, and specialized, very thick-walled hyphae in the context.

The difficulty in finding a suitable generic position has prompted me to delay describing a new species until more material is available and the extent of morphological variation is better known.

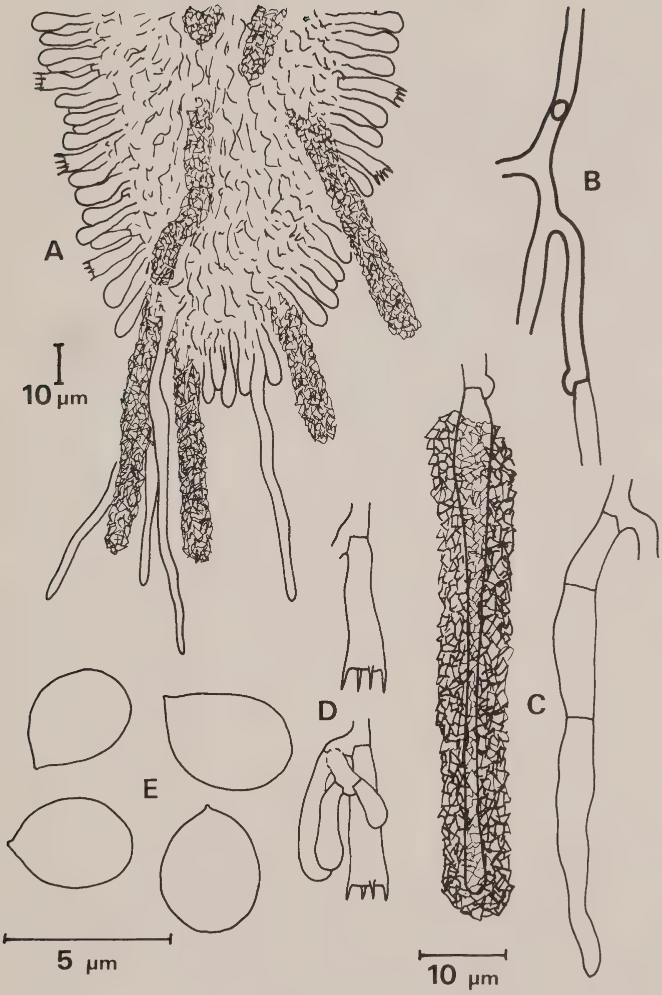

A
B
10 µm
C
D
E
5 µm
10 µm

Fig. 14. *Mycoacia* sp. A) section through aculeus B) context hyphae C) pseudocystidia D) basidia E) spores. — Coll. N. Hallenberg 2138.

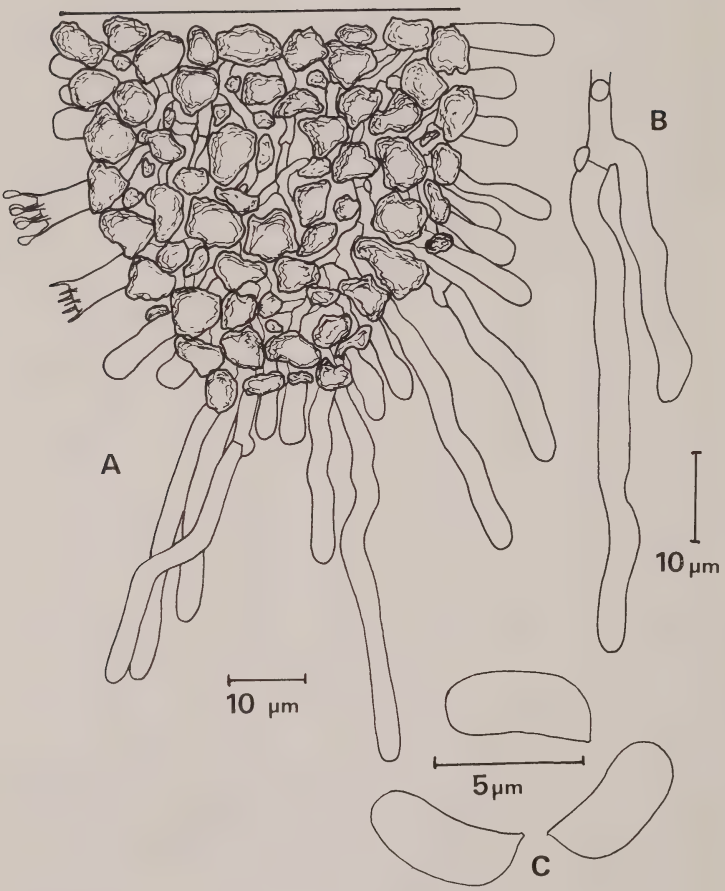

B
A
10 µm
10 µm
5µm
C

Fig. 15. *Sistotrema brinkmannii* s.l. A) section through aculeus B) widened hyphal ends C) spores. — Coll. N. Hallenberg 2325.

Sistotrema brinkmannii s.l. (see fig. 15)

SPECIMEN: Iran, Gorgan, Golestan forest/ On a fallen log/ 1978—05—01/ N. Hallenberg 2325.

This specimen differs from typical *S. brinkmannii* (Bres.) John Erikss. by the long, slightly widened hyphal ends, 30—65X2.5—3.5 µm, protruding from the apices of aculei. In the context there is abundant crystalline material.

ACKNOWLEDGEMENTS

I am much indebted to prof. J. Eriksson, Göteborg, for many valuable advices and discussions; to prof. J. Boidin, Lyon, for advices regarding the genus *Conferticium*.

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Dr. Paule Lanquetin, Lyon, has kindly isolated monosporous cultures from fructifications of *Peniophora pseudonuda*, which were sent to Lyon by mail from Iran.

T. Hallingbäck, Göteborg has made the photos, S. Carpenter, Göteborg, has checked the English and prof. Å. Frid, Göteborg, has corrected the Latin diagnosis. I greatly acknowledge their help.

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Finally, I want to thank the Curators of the Herbaria BPI, K, LY, P, and UPS for having kindly placed material at my disposal.

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A NEW SPECIES AND A NEW VARIETY OF PSILOCYBE FROM NORTH AMERICA

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SUMMARY

A new species from the Northwestern U.S.A., and a new variety from the Northwestern and Eastern U.S.A. are herein described. Both fungi exhibit the characteristic bluing feature shared by many of the hallucinogenic species in the genus *Psilocybe*. The new species contains psilocybin and psilocin and the new variety contains psilocybin but no psilocin.

INTRODUCTION

With the increased attention focusing on the hallucinogenic species of *Psilocybe* it is not surprising that new species and varieties are being discovered throughout the world. Guzmán and Vergeer (1978) listed 390 names of *Psilocybe* of which 210 are excluded taxa, and of which 73 are hallucinogenic. More recently, Guzmán (1978A), Guzmán and Pollock (1978,1979), Guzmán and Smith (1978), Guzmán and Horak (1978), and Guzmán and Lopez (in Guzmán et al., 1979) described several species, the majority having hallucinogenic properties.

The first decisive and thorough taxonomic survey of the bluing species in the genus *Psilocybe* was authored by Singer and Smith (1958). Heim (in Heim and Wasson, 1958) presented a study of the hallucinogenic species from Mexico, and later (in Heim et al., 1967) described additional hallucinogenic species from many regions of the world, including *Psilocybe semilanceata* (Secr. ex Fr.) Kumm., a species originally thought to be non-bluing and therefore excluded from the Singer and Smith monograph. Peck (1912), who reported *P. semilanceata* from the Eastern United States, studied the species in the genus *Psilocybe* endemic to New York State, though many of the species considered by him now belong to other genera (such as *Naematoloma* and *Psathyrella*). Guzmán et al (1976) presented a list of the known hallucinogenic species of *Psilocybe* from the northwestern region of North America where they seem very common. Recently, Stamets (1978) surveyed a majority of the known species in the genus from North America, including those previously described by Earle, Murrill, Kauffman, Ola'h and Heim, and Smith.

In the present paper a new species from the Pacific Northwest and a new variety from both the Northwestern and Eastern United States are described. Both fungi contain psilocybin and share a strong taxonomic relationship to other known hallucinogenic species.

Psilocybe cyanofibrillosa Guzmán and Stamets, sp. nov.

Figs. 1,3, & 4

Pileus 14-35 mm latus, conicus demum convexus, dein planus, laevis, viscidus, glaber udo striato, pellicula separabili intructus, flavido-brunneus, hygrophanous albido-alutaceus. Lamellae adnatae, pallidae demum brunnae. Stipe 30-70 x 1.5-4 mm, strictus, deorsum soride vinaceo brunnea vel pallide griseo-fibrillosa vel cyanofibrillosa. Sporis (9-) 9.5-11 (-12) x (5.5-) 6-6.6 (-7.1) μ, ellipsoideis, cocainus brunneolus. Pleurocystidiis nullis. Cheilocystidiis 22-33 x 5.5-7 μ, hyalinis, sublageniform. Cuticula pileorum gelatinosa. Gregariis vel caespitose in scobis substratum. Typus: Stamets 79-8, (ENCB), South King County, Washington, U.S.A.

Pileus 14-35 mm in diameter, conic to broadly convex, and eventually plane in age, deep chestnut brown, strongly hygrophanous, fading to pale tan to light yellowish brown, viscid when moist from a separable gelatinous pellicle. Lamellae adnate or adnexed to shortly subdecurrent, light grayish when young to purplish brown with age, moderately broad and with pallid edges. Stipe 30-70 x 2-4 mm, flexuous or straight, sometimes curved at the base, equal or enlarged downwards, longitudinally striate, fibrous, hollow to stuffed with a yellowish pith; surface light tan to yellowish brown, covered with fine light grayish fibrils that turn bluish in age or when touched. Veil copious at first, whitish and cortinate, leaving fibrillose remnants especially on the upper parts of the stipe, but not forming an annulus. Context brownish in pileus and stipe, mildly bluish when bruised.

Spores (9-) 9.5-11 (-12) x (5.5-) 6-6.6 (-7.1)µ, subelliptic in both face and side view, chocolate brown, thick wall, with a distinct apical germ pore. Basidia 22-28 x 6-9.5 µ, hyaline, ventricose or subpyriform, frequently with a median constriction, 4-spored or sometimes 2-spored, with sterigmata up to 5 µ long. Pleurocystidia absent. Cheilocystidia 22-33 x 5.5-7 µ, abundant, forming a sterile band at the edge of the lamellae, hyaline, fusiformlanceolate, sometimes subpedicellate, with an elongated neck, 1-1.5 µ broad, frequently irregularly incrusted on some walls. Epicutis formed by a thick gelatinous hyaline layer, with more or less parallel hyphae, no more than 4 µ in diameter. Hypodermium hyaline, with parallel filamentous hyphae, up to 20 µ in diameter, sometimes irregularly incrusted. Lactiferous hyphae 5-10 µ broad, commonly colored chocolate brown or pallid yellowish in the hypodermium. Clamp connections present, but not common.

Habitat. Growing in large colonies, caespitosely or subcaespitosely, sometimes scattered in small groups, in decayed urea-enriched fir sawdust during the fall.

Material studied. U.S.A., Washington, South King County.

Stamets 79-8(Type, ENCB); *Stamets 79-15* (ENCB); *Stamets 78-20* (ENCB); *Whitcher* (ENCB).

Discussion. This species is delimited from *P. baeocystis* Sing. & Smith emend. Guzmán (Guzmán, 1978, B) by its habit and the even non-undulated, non-incurved margin. Microscopically, this new taxon differs from *P. baeocystis* in the form of the spores, not being asymmetrical, and in their size ((8.5-) 9.5-13.7 (-17) x 5.5-6.6 (-7.1) µ in *P. baeocystis*). *P. cyanofibrillosa* is also close to *P. cya-*

nescens Wakef. but is easily distinguished from it by the lack of pleurocystidia. *P. pelliculosa* (Smith) Singer & Smith is another related species. However, the tendency of the pileus to expand to plane, the more fibrillose and bluing stipe, and the dark color of the spores (yellowish brown in *P. pelliculosa*), and the incrusted reddish brown pigmented hypodermium readily distinguishes *P. cyanofibrillosa* from that species. Further, the scarcity of clamp connections and the presence of lactiferous hyphae seem yet another set of characters typifying *P. cyanofibrillosa*.

This species is named for the fibrils adorning the stem, initially grayish and soon becoming bluish in age, or when injured.

Chemistry. Methanolic extracts of 3 collections of *Psilocybe cyanofibrillosa* were analyzed by high performance liquid chromatography using a reversed phase μC_{18} column and uv quantification at 254 nm. The solvent was 75% water; 25% methanol with 0.05M heptanesulfonic acid at pH 3.5.

Both psilocybin and psilocin were detected. The type collection, PS 79-8, contained 0.05 mg psilocybin per gram dry weight and 1.4 mg/g psilocin.

Two other collections made during the fall of 1979 were analyzed. One collection contained 0.31 mg/g psilocybin and 0.62 mg/g psilocin. The other contained 2.1 mg/g psilocybin and 0.4 mg/g psilocin. The observed variation of psilocybin and psilocin levels from one collection to another is typical of several species in the genus and leads us to the conclusion that neither the level of psilocybin and psilocin nor the ratio of the two can be utilized as a chemotaxonomic tool. Further, when we analyzed two herbarium collections of *Psilocybe cyanofibrillosa* from 1978, we found that they had lost most of their psilocybin and psilocin. We thus conclude that collections should be analyzed promptly. However, activity can be retained for at least two years by drying or freeze drying the collections, sealing them in plastic, and storing frozen.

Additional confirmation of the presence of indolealkylamines was obtained by Thin Layer Chromatography (TLC) with n-Butanol/Acetic Acid/Water (12/3/5). Developed plates were examined under short-wave ultraviolet light, then sprayed with Ehrlich's reagent (10% p-dimethylaminobenzaldehyde (pDAB) in concentrated hydrochloric acid diluted

1 to 4 with acetone). The type collection and one other collection from 1979 were analyzed. *Psilocybe cyanofibrillosa* produced 7 separate spots: R_f 0.18, a brownish spot identical to psilocybin in both R_f and color; R_f 0.33, a sky-blue spot of an unidentified compound; R_f 0.42, a blue-purple spot identical to psilocin in R_f and color; as well as four additional spots visible under UV but only slightly resolved by pDAB - R_f 0.5; R_f 0.65; R_f 0.83 and R_f 0.93.

Based on an examination of *Psilocybe* in the Pacific Northwest, we have found the chromatographic patterns of each species to be of potential chemotaxonomic use. The intensity of each chromatographic spot varies from collection to collection, but the number of and location of spots is fairly constant within each species. It is interesting to note that microscopically *Psilocybe cyanofibrillosa* is quite similar to *Psilocybe baeocystis* Singer and Smith emend. Guzmán. Their TLC chromatographic patterns are also quite similar.

Psilocybe liniformans Guzmán & Bas, var. *americana* Guzmán & Stamets, var. nov.

Figs. 2 & 5

A var. typus differt lamellae margine nulla elastica. Sporis et cheilocystidiis ut in var. typus. Pratensis ad terram. Typus: Stamets 79-12, November 1979, Oyster Bay Road, Thurston County, Olympia, Washington, U.S.A., (ENCB).

This variety is very close to the type variety, but differs in the absence of the gelatinous layer on the edge of the lamellae, as well as in the terricolous habitat. The other macroscopic and microscopic features are the same, even the bluing reaction.

P. liniformans var. *liniformans* was described (Guzmán & Bas, 1977) from the Netherlands, growing on dung in a pasture. The gelatinized edge of the lamellae is the most prominent feature delimiting it from other similar species. The new variety described here is known only from Washington, Oregon, and Michigan in the U.S.A.. It is close to *P. callosa* (Fr. ex Fr.) Quel. and *P. semilanceata* (Secr. ex Fr.) Kumm., but differs from the former in the size of the spores, (9.5-) 10-12 (-14.5) x (6.5-) 7-8.5 µ and in the size of the cheilocystidia, 20-45 x 4-7 µ in that species. From *P. semilanceata* this species differs in its non-umbonate pileus and in its wider spores (x (6-) 7-8 µ in *P. semilanceata* and x 7.5-10 µ in *P. liniformans*.)

Habitat. Scattered on soil in a field.

Material studied. U.S.A., Michigan, Cheyboygan, *Smith 35963* (MICH); Washington, Thurston County, Olympia, *Stamets 79-12* (Type, ENCB); Oregon, Corvallis, *Morgan* (Nov. 1979) (ENCB).

Chemistry. Methanolic extracts of 7 collections of *Psilocybe liniformans* var. *americana* were analyzed by high performance liquid chromatography. Psilocybin but no psilocin was detected. The type collection, PS 79-12, contained 5.9 mg psilocybin per gram dry weight. The other collections contained levels of psilocybin ranging from 6.5 mg/g to 12.8 mg/g (average 8.9 mg/g). The high performance liquid chromatograms of *Psilocybe liniformans* var. *americana* are quite similar to those of *Psilocybe semilanceata* (Secr. ex Fr.) Kumm. Herbarium samples of these two species both appear to retain their activity, unlike most other *Psilocybe* species analyzed to date.

Thin layer chromatography of extracts of *Psilocybe liniformans* var. *americana* produced 6 spots: R_f 0.26, identical to psilocybin; R_f 0.31, the same color as psilocybin; R_f 0.34, a light brown, barely visible; R_f 0.44, a sky blue; R_f 0.55, a light blue; R_f 0.94, a brown color. No psilocin was detected. The TLC Chromatographic pattern is very close to that of *Psilocybe semilanceata*.

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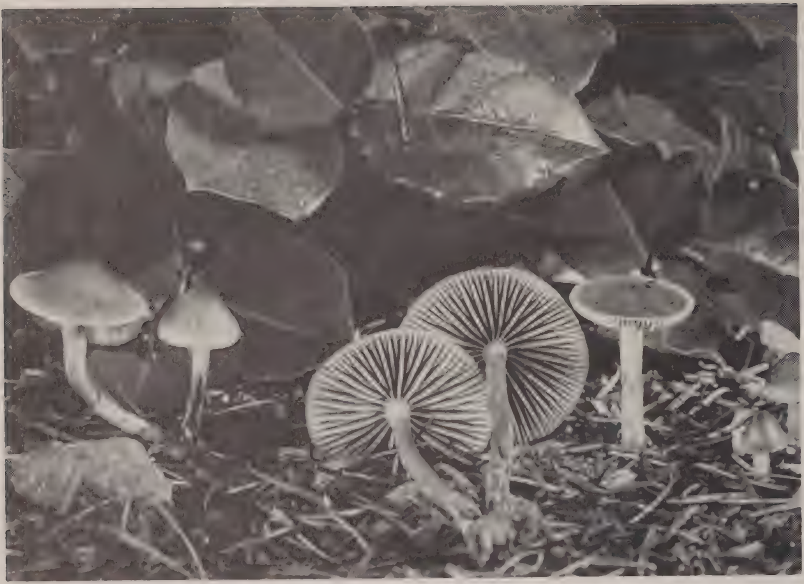
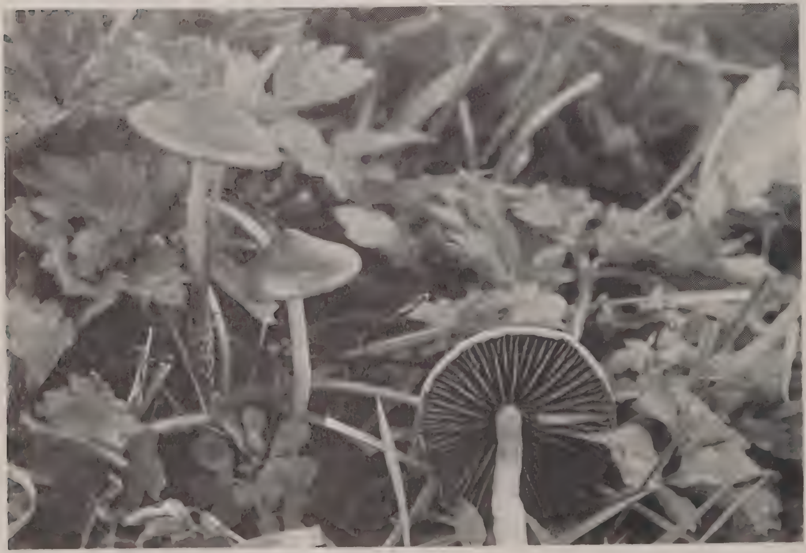
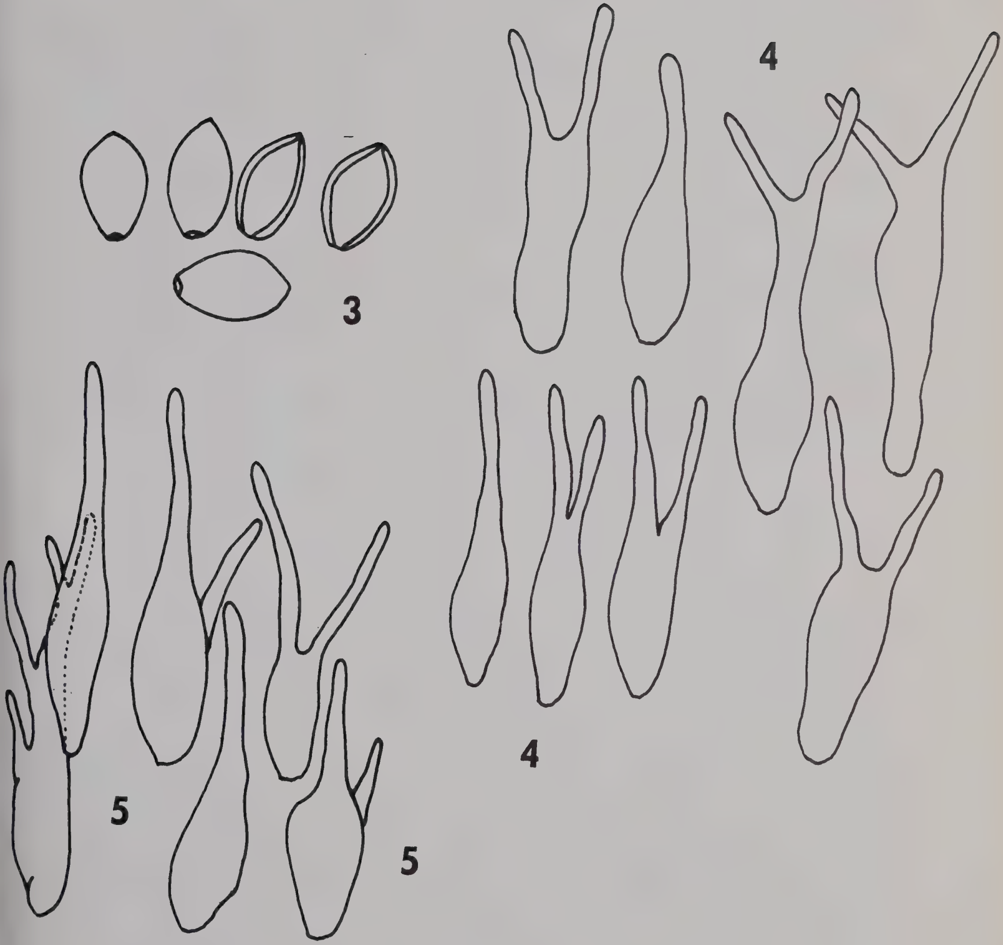


Figs. 1-2 1(above): *Psilocybe cyanofibrillosa* Guzman & Stamets, fruit bodies in the habitat (type). 2(below): *Psilocybe liniformans* var. *americana* Guzman & Stamets, fruit bodies in the habitat (type) (Photos - Stamets).





Figs. 3-5 *Psilocybe cyanofibrillosa*; 3: Spores; 4: Cheilocystidia (both from the type); 5: *Psilocybe liniformans* var. *americana*, cheilocystidia(type).

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NOTES ON PERITHECIAL DEVELOPMENT IN THE EUCERATOMYCETACEAE FAM. NOV. (LABOULBENIALES, LABOULBENIINEAE) AND HERPOMYCES (HERPOMYCETINEAE)

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SUMMARY

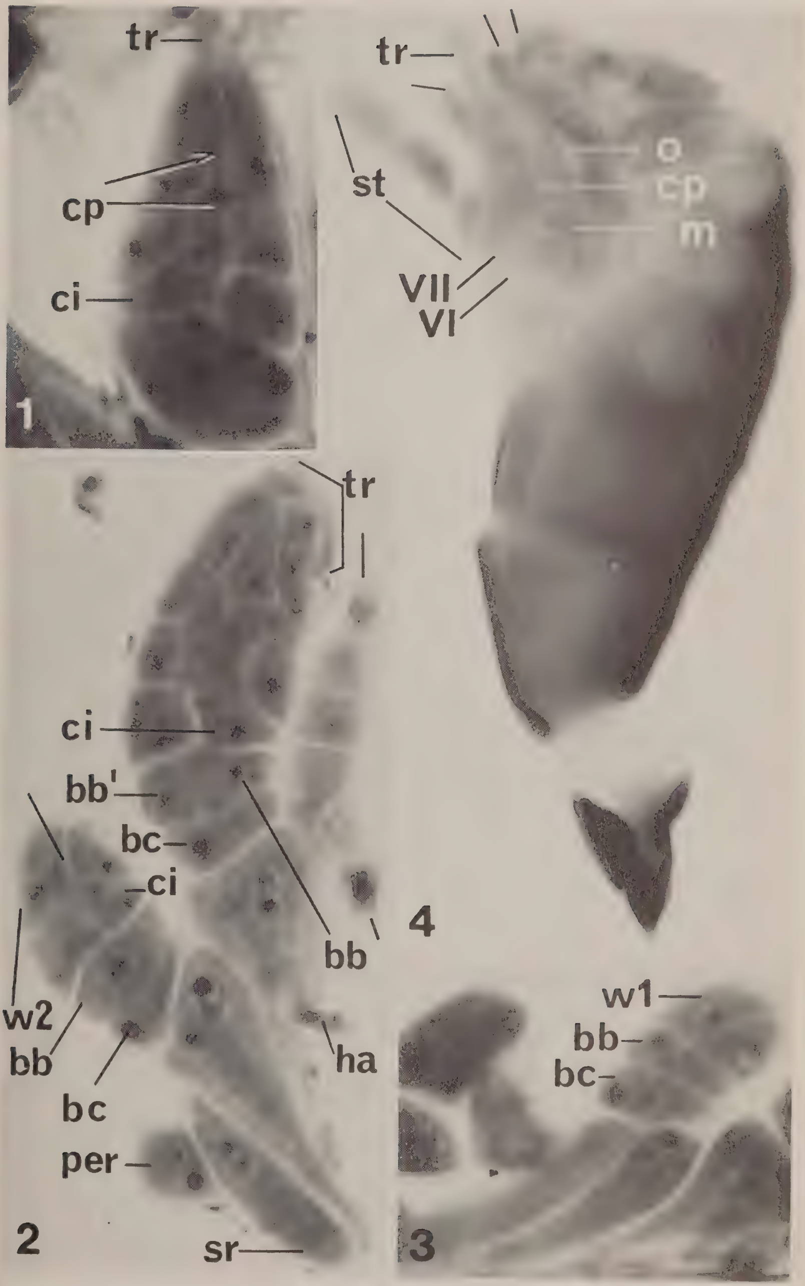
The family Euceratomycetaceae has been established for those genera in the Laboulbeniales in which the stalk and secondary stalk cells of the perithecium are intercalary cells of a lateral appendage of the primary axis of the thallus. As in the other families of the Laboulbeniineae, which include all genera of the order except *Herpomyces*, the outer wall cells of the perithecium grow up around the carpogonium; by contrast, in *Herpomyces* (Herpomycetineae [Thaxt.] stat. nov.), the carpogonium grows upward between the rows of outer wall cells.

Although Thaxter illustrated the stalk appendage of *Euceratomyces terrestris* (Thaxt.) Thaxt. (pl. XXV, fig. 19, 1896), he did not mention it when he described this taxon as *Ceratomyces terrestris* in 1894. Study of additional material called his attention to this structure (1931), which he described as an accessory appendage arising from the outer, upper basal cell of the perithecium (a cell that he did not associate with the secondary stalk cell of such taxa as *Stigmatomyces baeri* [Knoch] Peyr.--designated *h* in pl. I, figs. 12, 13, 1896). Because of this appendage, he transferred the species to a new genus, although he did not remove it from the Ceratomyceteae.

The relationship of the stalk appendage to the cells of the young perithecium of *Euzodiomyces lathrobii* Thaxt. was shown by Cépède and Picard (pl. IV, fig. 5, 1909); however, they referred to the structure only as a lateral appendage of the perithecium. A greater understanding of the significance of this appendage was shown by Spegazzini (1912) when he indicated that the basal cell of the secondary axis of *Cochliomyces argentinensis* Speg. was laterally perithecigerous.

Figs. 1-3. *Herpomyces ectobiae* Thaxt. (on antennae of *Blattella germanica* [L.], Life Sciences Building, University of California, Berkeley, 1955; acetocarmine). 1. Perithecium in which lower left vertical row of outer wall cells consists of 4 cells and the other 3 rows have 3 cells each; carpogonium-initiating cell (*ci*) has produced upward extension that has emerged apically as a trichogyne (*tr*). Arrow indicates third septum in lower left wall row; nucleus in carpogonium (*cp*) is indicated by line. X 2475. 2. Young female thallus; 4-celled primary axis is at right (lines point to foot at base and dark upper end); tall secondary receptacle cells (*sr*) are produced by suprabasal cell of primary axis--they extend at their bases into haustoria (*ha*); 1-celled perithecial bud is at base of thallus (*per*); second perithecium has 2 tiers of outer wall cells (which are designated *w1*, *w2* in figures), subtended by 2 basal cells (*bb, bc*); *ci* cell is beginning to extend upward between the outer wall cells (upper edge indicated by line above); upper perithecium is 4-tiered; it bears a deteriorating trichogyne; its *ci* cell has produced 3 central upgrowths; cell *bb* has produced cell *bb'*. X 2070. 3. Portion of young female thallus showing perithecia with only 4 outer wall cells. X 2380.

4. *Euceratomyces terrestris* (Thaxt.) Thaxt. (on leg of *Lathrobium*, Kittery Point, Maine, R. Thaxter, August, 1895; acetocarmine). Immature thallus, showing manner in which perithecium develops from secondary axis terminating in stalk appendage (*st*); cells *VI* (perithecial stalk cell) and *VII* (secondary stalk cell) are intercalary cells of this axis. Carpogonium (*cp*) subtends trichogyne cell; first outer wall cell (*o*) is produced by basal cell *m*, formed from *VI*. Lines above indicate branches of primary axis of thallus. X 1900.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In his description of *Colonomyces*, Benjamin (1955) emphasized that the stalk cell of the perithecium is one of the intercalary cells of the secondary axis bearing the perithecium and that the terminal part of the axis extends beyond the mature perithecium as an appendage. However, he made no comparison with *Euzodiomyces*, which he had studied earlier (see Benjamin and Shanor, 1951). When Rossi (1977) established the new genus *Pseudoecteinomyces*, he recognized its relationship to *Cochliomyces*. His figs. 1 and 4 show the 3-celled secondary axis clearly; there is no indication of a stalk appendage extending beyond the solitary cell superposed upon the secondary stalk cell of the perithecium. With the exception of the numerous, short outer wall cells, the perithecium of *Pseudoecteinomyces* is very similar to that of *Stigmatomyces* in basic structure; however, the stalk in *Stigmatomyces* consists of only 2 cells, not 3. The perithecia of *Euceratomyces*, *Euzodiomyces*, *Colonomyces*, *Cochliomyces*, and *Pseudoecteinomyces* develop from a lateral appendage (which because it bears a perithecium is referred to as a secondary axis) in the same manner that the perithecium of *Ceratomyces* arises from the primary axis of the thallus (see Thaxter, 1896, pl. XXIV, figs. 4, 7); in addition, they are characterized by outer wall cells that are subequal in height and usually very numerous (this is considered to be a primitive characteristic). Consequently these 5 genera are being placed in a new family, the Euceratomycetaceae.

Familia Euceratomycetaceae nom. nov. Cellula pedicellaris et cellula pedicellaris secundaria perithecii sunt cellulae continentes appendicis lateralis ex axe primario thalli, appendice basim perithecii superante sed saepe caduca, cellulas 1 vel 2 ad latus exterius basis perithecii affixas relinquente. Perithecii paries exterior ex seriebus quattuor verticalibus cellularum constans, serie quaque ex cellulis brevibus quattuor vel pluribus altitudine subaequis composita. Receptaculum inferius infra perithecium ex cellulis plus quam duabus constans. Antheridia phialides sunt vel cellulae intercalares non speciales spermatia lateralia producentes.

Typus: *Euceratomyces* Thaxter, 1931, p. 343.

There are more than 2 cells, often very many, in the receptacle below the perithecium. As in the other families of the Laboulbeniales, the outer wall of the perithecium consists of 4 vertical rows of cells. Phialides occur in all genera; in addition, lateral, exogenous spermatia are formed by undifferentiated intercalary cells of the appendages of *Euceratomyces* (additional observations will be reported in a later, general paper on the Laboulbeniales).

The perithecium in the Euceratomycetaceae develops like that of *Laboulbenia* and *Stigmatomyces* (see Thaxter, 1896). The carpogenic cell row extends upward from the secondary stalk cell; it terminates in a trichogyne. Three basal cells (*n*, *n'*, and *m*) are formed from the stalk cell (cell *VI*) and the secondary stalk cell (cell *VII*); each of the 3 cells produces 1 vertical row of outer wall cells; in addition, cell *n* produces a second row. These wall cell rows grow up around the carpogonial cell row (figs. 4, 5).

By contrast, the perithecial walls in *Herpomyces* are formed before the carpogonial upgrowth (figs. 1-3; cf. Tavares, 1965, 1966). Only *Herpomyces* has this characteristic and it is therefore being placed in the suborder Herpomycetineae. The remaining genera are being grouped in the suborder Laboulbeniineae because of the similarity of their perithecial development (an extensive discussion of their interrelationships will be published in a later paper).

Both *Herpomyces* and the genera of the Euceratomycetaceae, with the exception of *Colonomyces* (in which the outer wall cells are poorly developed and are 4-5 in number), have many outer wall cells (see fig. 7), more or less equal in height, in each vertical row. *Herpomyces* is unusual in having 8 spores with median septa in each ascus. Benjamin and Shanor (1951) reported that there are 8-spored asci in *Euzodiomyces*, although they did not show how the spores are arranged (see Cépède and Picard, 1909). *Euceratomyces* also has 8 spores in the ascus, although, like those of *Laboulbenia* (characterized by the more common 4-spored ascus), the spores have a small lower cell that becomes the appendage when the spore is inverted after discharge from the perithecium (fig. 6).

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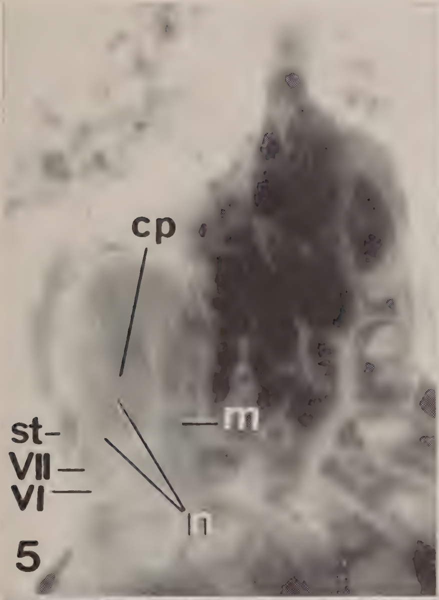
Figs. 5-7. *Euceratomyces terrestris* (same collection as fig. 4; acetocarmine). 5. Portion of young thallus bearing 3-tiered perithecium; upper and lower septa of cell *n*, which produces 2 vertical wall cell rows, are indicated by lines; stalk appendage extends beyond perithecium; trichogyne has disappeared; appendages of primary axis are at right. X 1900. 6. Squashed mature perithecium; upper arrow indicates upper end of 1 apical cell; v-line shows height of wall cell; short lines show location of 7 spore septa within one ascus; arrow in center left indicates large nucleus of large cell of one spore. X 1900. 7. Mature thallus; inner layer of wall cells (*p*) is indicated at left; asci (*as*) in lower part of perithecium are immature; arrow at base indicates outer edge of outer wall cell; lines below point to cell *VII* below and basal cell of stalk appendage above (remainder of appendage has fallen off). X 1107.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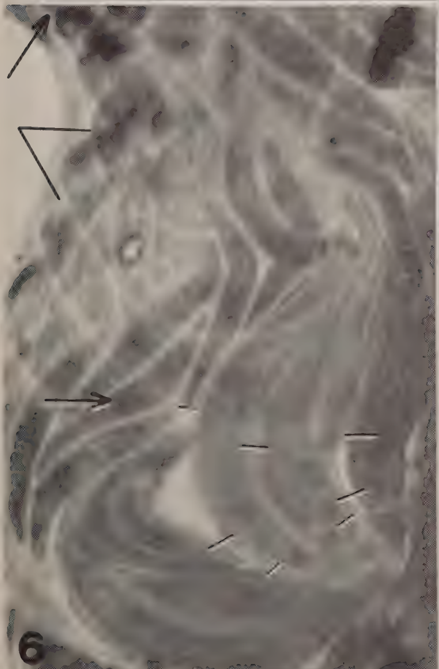
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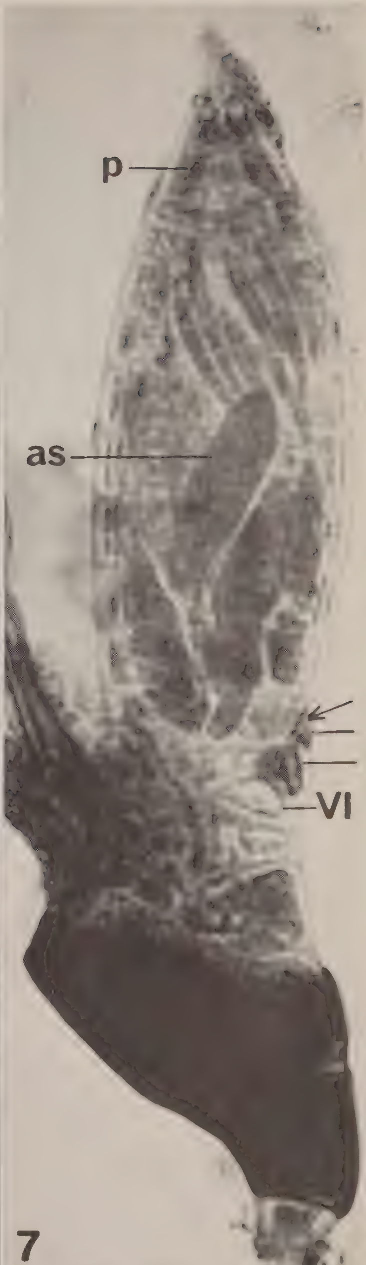
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NOTICE

MYCOLOGICAL SOCIETY OF AMERICA GOLDEN JUBILEE

The Mycological Society of America will celebrate the 50th anniversary of its founding during August 9-14, 1981, at Indiana University, Bloomington, Indiana, USA.

All mycologists are invited to participate in their Anniversary Program. It is anticipated that the event will include addresses and symposia dealing with the past, present, and future of mycology and of the Society. Attendance and contributions from colleagues throughout the world will be welcomed.

Jack D. Rogers, Chairman
Golden Anniversary Committee
Mycological Society of
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REVUE DES LIVRES

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INSECT-FUNGUS SYMBIOSIS, NUTRITION, MUTUALISM AND COMMENSALISM, Proceedings of a symposium at the Second International Mycological Congress, Aug. 27-Sept.3,1977, University of South Florida, Tampa, Florida, par Lekh R. BATRA éd., xii + 276 p., figs., 53 pls. phot. 8°, relié, toilé, nov. 1979, Allanheld, Osmun & Co.19, Brunswick Rd, Montclair, N.J. 07042, USA.John Wiley & Sons, Chichester, UK. Prix £16.80.

Onze spécialistes des interactions entre champignons et arthropodes ayant tenu un symposium à Tampa en 1977 se sont concertés et deux ans plus tard publient ce livre. Un livre excellemment édité, imprimé et illustré. Aussi, un livre passionnant. Ce Symposium a fait la synthèse des connaissances actuelles et a dégagé des voies d'une recherche future. A travers les multiples aspect de la relation champignon-arthropode (taxonomie, développement, reproduction, nutrition, biochimie, morphologie, écologie), sept types de symbioses ont montré divers niveaux de mutualisme, de commensalisme ou de parasitisme. La symbiose entre champignon (*Ambrosiella, Fusarium*) et les *Xyleborus* (ambrosia beetles) est un cas de mutualisme (= symbiose obligée) où le mycosymbionte est en ectosymbiose sauf au niveau du mycétange. Le champignon est indispensable à l'alimentation de l'insecte, lui fournissant ergostérol, phospholipides, acides gras et acides aminés. Le mutualisme entre les levures et les Anobiidae est une endosymbiose où le champignon, intracellulaire, est source de vitamines, de choline, de stérols. Par contre les champignonières (fungus gardens) des fourmilières et des termitières représentent des symbioses par commensalisme. Les champignons des fourmilières (*Xylaria, Lepiota, Rozites*) et ceux des termitières (*Termitomyces* et *Xylaria,* aidés de bactéries cellulolytiques en parasymbiose) réalisent une décomposition enzymatique du gateau ligneux, l'enrichissant en sucre et en azote pour l'élevage des larves et l'alimentation des adultes. La symbiose des Siricidae (woodwasps)avec des nématodes et le *Stereum sanguinolentum* est un commensalisme, où insecte a besoin du champignon mais ne le consomme pas. Il semble que le commensalisme des Trichomycètes soit de sens inverse, ceux-là trouvant abri et nourriture dans le tractus de l'hôte.Les études biochimiques, morphologiques et ultrastructurales des Trichomycètes révèlent des affinités avec les Kickxiellacées. Enfin le commensalisme devient un parasitisme obligé chez les Laboulbeniales des insectes. Ici la spécificité d'hôte est stricte. Les diverses synthèse taxonomiques présentées dans plusieurs cas augmentent encore l'intérêt du livre.

FLORA CRIPTOGAMICA DE TIERRA DEL FUEGO, Tome XI, Fasc. 3: FUNGI, BASIDIOMYCETES, APHYLLOPHORALES, FISTULINACEAE, MUCRONOPORACEAE, POLYPORACEAE, par Jorge E. WRIGHT et Jorge R. DESCHAMPS, 62 p., 9 pls., 8°, broché, 1975. Fundación para la Educación, la Ciencia y la Cultura, Moreno 431, Buenos Aires, Argentina. Prix non donné.

Les 15 espèces d'aphyllophorales décrites en provenance de la Terre de Feu appartiennent aux genres *Fistulina, Pyrrhoderma, Inonotus, Bjerkandera, Spongipellis, Piptoporus, Coriolus, "Poria", Schizopora Polyporus.* Trois combinaisons nouvelles sont proposées. L'étude se base sur les récoltes de Spegazzini de 1887 à 1926, celles d'Irma Gamundi et de Rolf Singer et celles des auteurs. Une liste de 11 espèces signalées par d'autres et non retrouvées par les auteurs est commentée. Notons la haute qualité des descriptions et des dessins.

FLORA CRIPTOGAMICA DE TIERRA DEL FUEGO, Tome X, Fasc. 1: FUNGI, FUNGI IMPERFECTI, HYPHOMYCETES, par Alicia M. GODEAS, Silvia G. MARCHAND et Daniel CABRAL, 121 p., 19 pls., 8° broché, 1977, Fundación para la Educación, la Ciencia y la Cultura, Moreno 431, Buenos Aires, Argentina. Prix non indiqué.

Les auteurs, de l'Université de Buenos Aires, ont effectué une prospection des sols et de litières de la Terre de Feu; ils ont également réexaminé les récoltes de Spegazzini datant de 1887,1923 et 1924. Adoptant la classification traditionnelle de Saccardo, basée sur la couleur des hyphes et des conidies, bien qu'ils utilisent la terminologie conidiogénétique morderne, ils décrivent et classent 46 espèces dans les familles Dematiaceae et Moniliaceae. Ce choix du système de Saccardo met les auteurs dans l'embarras puisqu'ils en arrivent à placer *Aspergillus* dans les deux familles.

TAXONOMY OF FUNGI, Proceedings of the International Symposium on Taxonomy of Fungi, University of Madras, 1973, PART I. par C.V. SUBRAMANIAN éd., 304 p., ill., 41 pls. hors-texte, 8° broché,1978. University of Madras, Centre of Advanced Study in Botany, Madras-600 005 India. Prix £ 5.-.

Ce volume n'est que la première partie des communications du Symposium organisé par le Prof. C.V. Subramanian en 1973 à Madras. C'est grâce aux efforts soutenus de l'éditeur que ce volume a vu le jour,et que le second nous est promis. Les 31 communications reproduites le sont intégralement, avec l'illustration; elles sont pour moitié d'auteurs indiens, pour l'autre d'auteurs invités. Les 9 premières communications traitent des Myxomycètes et des Champignons inférieurs, en particulier de la taxonomie et de la phyllogénie des Myxomycètes, des Chytridiomycètes, des Hyphochytridiomycètes, des Oomycètes, des Mucorales et des "marine biflagellate fungi". Les autres communications traitent des Ascomycètes ou de leurs anamorphes.Les uns étudient les problèmes taxonomiques des *Fusarium*, *Alternaria*, *Drechslera, Verticillium, Candida, Trichosporon.* Certains cherchent des solutions dans la génétique ou la sérologie, ou encore l'histochimie ou la karyologie. Les autres traitent des problèmes taxonomiques de groupes plus importants, des Hémiascomycètes, des Cleistoascomycètes, en particulier des Chaetomiales, des Pyrénoascomycètes, spécialement des *Phyllachora* et *Hypoxylon* et des Discoascomycètes. Bien qu'on peut y trouver quelques coquilles, ce volume très bien imprimé et illustré à un prix modique sera largement apprécié comme une contribution importante.

TAXONOMY AND DISTRIBUTION OF FUNGI (AGARICALES, ERYSIPHALES, HELOTIALES), par K. KALAMEES, P. POLDMAA et A. RAITVIIR, 160 p., 12°, broché, 1978, Academy of Sciences of the Estonian S.S.R., Institute of Zoology and Botany, Tartu, Estonia. Coll. Scripta Mycologica n° 8. Prix 20 roubles.

Ce fascicule, composé de 4 articles, est partiellement en anglais et partiellement en russe. Kalamees donne une liste des Polyporales, Boletales, Russulales et Agaricales d'Estonie, regroupant 735 espèces, 56 variétés et 10 formes. Dans une étude chorologique des Agaricales, il en étudie la distribution. Pôldmaa relève 46 espèces d'Erysiphales sur 162 hôtes en Estonie. Raitviir revoit la systématique de *Cistella* (Discomycètes), y décrit 6 nouvelles espèces *C. arctica, C. conorum, C. orientalis, C. tianschanica, C. turkomanica, C. tuvensis* et y redispose 12 autres espèces. De plus il décrit les genres nouveaux *Venturiocistella (V. venturioides* spec. typ.) et *Cistellina (C. auricolor* spec. typ.).

MR JONATHAN OTT'S REJOINDER TO DR ALEXANDER H. SMITH, par Jonathan OTT, Ethnomycological Studies n° 6 (R. Gordon WWasson éd.), 11 p., 8°, 1978, Botanical Museum of Harvard University, Cambridge, Mass.

J. Ott répond à une opinion critique de A.H. Smith (Mycologia 69: 1196, 1977) au sujet d'une critique d'un de ses articles par Ott dans son livre *Hallucigenic Plants of North America* (1976). Ott retrace ensuite les circonstances de la mise à jour par V.P. et R.G. Wasson et ensuite par feu le Professeur Roger Heim de l'usage de champignons hallucinogènes au cours de cérémonies shamanes au Mexique. Il explique alors comment *Psilocybe muliercula* Singer & Smith a pris priorité sur *Psilocybe wassonii* Heim.

HONGOS, par Gaston GUZMAN, 194 p. 186 figs. col., 8°, papier, 1978, Editorial Limusa, Arcos de Belen 75 Mexico 1, D.F. Prix $ 7.-.

Ce livre, pour amateurs, décrit en langue espagnole les principales espèces du Mexique. Chaque espèce est illustrée d'une photographie en couleurs dont la reproduction est en certains cas malheureusement défectueuse.

FUNGI, DELIGHT OF CURIOSITY, par Harold J. BRODIE, 131 p., 21 figs., 8° relié, juin 1978, University of Toronto Press, Toronto M5S 1A6, Canada. Prix $ 10.-.

Si les champignons sont un plaisir pour les yeux et l'esprit qui les découvrent, ce livre est lui aussi un divertissement agréable pour le lecteur, qu'il soit ou non mycologue. Ici ce n'est plus l'oeil observateur du scientifique qui scrute au travers de la loupe les réalités vivantes du monde microscopique, mais c'est le regard de l'homme qui, à d'autres dimensions et comme dans le rêve, vit la beauté, l'harmonie, le mouvement, la force, la malice, la combativité, l'habileté, la brillance, la préciosité, la sociabilité, l'endurance d'êtres apparemment fragiles et éphémères, les champignons.

EPISTOLAE MYCOLOGICAE VIII. Indexes to Matsushima's *Microfungi of the Solomon Islands and Papua-New Guinea* (1971) and *Icones microfungorum a Matsushima lectorum* (1975), par Gilbert C. HUGHES, in *Syesis*, 11:135-169, 1978. Department of Botany, University of British Columbia, Vancouver V6T 1W5, Canada.

Il est heureux que G.C. Hughes ait publié ces index des deux livres de Matsushima que nous avons déjà recensés.

THE MYCOLOGICAL ASSOCIATION OF M.J. BERKELEY AND M.A. CURTIS, par Ronald H. PETERSEN, 120 p., 2 portraits en couverture, 4 ill., 12°, broché, 1980, J. Cramer, FL-9490 Vaduz, Liechtenstein. Prix DM souscr. 24.-/30.-.

Des hazards heureux, et une curiosité innée pour les témoignages du passé, ont poussé l'auteur sur le chemin de la découverte des correspondances de Berkeley à Curtis et de Curtis à Berkeley.De là est né ce livre que tout mycologue ayant la passion de la science qu'il pratique devrait lire. Ronald Petersen nous présente, discrètement commentés, une succession chronologique d'extraits des lettres du mycologue anglais et de l'américain, échangées de 1846 à 1872. Après les travaux de von Schweinitz, qui jeta les fondements de la mycologie américaine, Curtis, guidé, aidé et encouragé par Berkeley, fit progresser celle-ci durant près de 30 ans pour alors laisser la main à Peck, J.B.Ellis et d'autres. Des notes diverses, intervenant dans le déroulement de cette histoire, comme par ex. le voyage de Corda au Texas et sa mort par naufrage lors de son retour, sont groupées en une seconde partie. Enfin en dernière partie, un manuscrit conjoint de Berkeley et Curtis, resté inédit depuis 1859, est aujourdhui publié: *A Commentary on the Synopsis Fungorum in America Boreali media degentium,* un commentaire sur les champignons de Schweinitz. Des études historiques de ce genre sont certainement souhaitables.

FUNGI EXSICCATI SUECICI, PRAESERTIM UPSALIENSES, Mandatu Collegii ex Elia Friesio nominati, FASC. LVII-LX (N° 2801-3000), INDEX N° 1-3000, par †Seth LUNDELL et J.A. NANNFELDT, vi + 145 p., 1 portr. broché, 1979, Uppsala, Institute of Systematic Botany.

Le Comité Elias Fries doit être félicité pour avoir, après la mort de Seth Lundell, facilité la préparation et la publication de ce dernier Fascicule des *Fungi exsiccati suecici.* Le contenu est le suivant: les exsiccata 2801-950 sont des Hyménomycètes, les 2950-3000 sont des Ustilaginales et des Urédinales. J.A. Nannfeldt y ajoute la correction de 45 étiquettes d'exsiccata précédemment publiées. Enfin, un index des noms de genres de l'ensemble est ajouté, où les épithètes spécifiques sont disposées dans les genres.

IDENTIFICACIÓN DE LOS HONGOS COMESTIBLES, VENENOSOS, ALUCINANTES Y DESTRUCTIVOS DE LA MADERA, par Gastón GUZMAN, 452 p., 218 pls. phot. b.n., 4°, briché, 1979, Editorial Limusa , Arcos de Belén 75, México 1, D.F. (première réimpression). Prix $ 9.-.

Cette contribution à la flore mycologique du Mexique n'a l'humble prétention que de fournir une clé illustrée d'identification des champignons supérieurs, pour la plupart des Basidiomycètes.Mais à la fois par les 582 espèces de champignons qui y sont décrits et illustrés, et par cette illustration de 217 planches de pleine page constituées en moyennede 6 bonnes photographies ou d'un plus grand nombre de dessins au trait, ce livre a une valeur incontestable. Cependant 170 des 194 pages de textes constituent un ensemble de 28 clés dichotomiques dont les dichotomies successives et surtout ultimes constituent les descriptions d'espèces. Cette présentation rend les clés très longues et d'un usage fastidieux et n'a plus l'ordonnance systématique et claire des familles, genres et espèces. De plus, ces clés descriptives ne font état que de caractères macroscopiques, ignorant totalement les caractères microscopiques.Cependant, de bons index facilitent la recherches des illustrations d'espèces.

NORTH AMERICAN SPECIES OF *LACTARIUS*, par L.R. HESLER et A.H. SMITH, x + 841 p., 249 figs., 154 pls. phot. b.n., 147 spores pls., 8°, relié, 19 oct.1979, The University of Michigan Press, Ann Arbor, USA. Prix $ 25.00.

Chacun sait combien riches et difficiles sont les deux genres de Russulaceae, *Lactarius* et *Russula*. Les Lactaires d'Europe ont été traités dans les flores de Bresadola (1928) de Konrad et Maublanc (1924-37), de Lange (1940), de Kühner et Romagnési (1953), ainsi que dans les monographies de Knauth et Neuhoff (1937) et de Neuhoff (1956). Par contre les Lactaires d'Amérique du Nord n'ont jamais fait l'objet que d'études partielles par Burlingham (1907-45), Coker (1918), Earle (1902), Peck (1872-1915), Kauffman (1918), Murill (1938-48), Hesler et Smith (1960-62) et Shaffer (1964). C'est donc bien la première monographie des Lactaires d'Amérique du Nord que publient les auteurs dans une édition très soignée et abondamment illustrée. Les descriptions font état des caractères macro et microscopiques, de l'anatomie du carpophore, de l'ornementation de la paroi sporale observée en SEM et illustrée dans un atlas des spores en annexe, et sur de très amples récoltes. Les auteurs divisent le genre en 6 sous-genres: *Lactarius (L. déliciosus)*, *Plinthogalus (L. lignyotus)*, *Lactifluus (L. volemus)*, *Piperites (L. torminosus)*, *Tristes (L. argillaceifolius)*, *Russularia (L. subdulcis)*, groupant un total de 200 espèces, sans compter de nombreuses variétés. Beaucoup d' espèces et variétés sont nouvelles. Un appendice réunit les espèces qui n'ont pu être vérifiées et celles qui ne sont pas américaines mais pourraient l' être.Un 2e appendice groupe les espèces à rejeter et douteuses. L'ornementation des spores est illustrées de manière traditionnelle, observée après coloration, et au SEM. Beaucoup d'espèces dépassant les limites de l'aire décrite, l'audience de ce livre dépasse de loin l'Amérique du Nord et tendra à s'identifier au monde mycologique.

MUSHROOMS: A SEPARATE KINGDOM, par Loni PARKER, texte de David T. JENKINS, 112 pages, 90 reproductions d'aquarelles de l'auteur, 4°, relié, toilé, 1979, Oxmoor House, P.O.B. 2262, Birmingham, Alabama 35202, USA. Prix $ 16.95.

Rarement, les champignons ont été si délicatement et agréablement dépeints. Les aquarelles de Loni Parker si naturelles, si précises, si riches en contours et en couleurs, parsemées dans le texte qu'elle a entièrement écrit de sa main dans un caractère Renaissance germanique, font de ce livre un joyau. Le texte de Jenkins fait apparaître les champignons dans l'équilibre de notre biosphère et sa survivance, comme des êtres mystérieux mais indispensables. S'ils peuvent être comestibles ils sont aussi vénéneux, ou encore hallucinogènes et,pour cette raison, objets de culte ou de superstitions. Un très beau livre, ornement des bibliothèques et cadeau rêvé pour les amis.

DE FUNGI VAN NEDERLAND. HET SYSTEEM VAN DE FUNGI.TABEL VOOR DE HOOFDGROEPEN EN VERWIJZING NAAR DE DETERMINATIE-WERKEN, par W.GAMS, Wetenschappelijke mededelingen K.N.N.V. 136, 115 p. ill. nov. 1979, Koninklijke Nederlandse Natuurhistorische Vereniging, Draafsingel 36, NL-1623LB Hoorn, Nederland.

Présentation en langue néerlandaise d'une clé dichotomique des diverses classes de champignons des Myxomycètes aux Deuteromycètes et jusqu'aux genres et aux espèces principales. Les diverses clés sont abondamment illustrées de petites figures au trait.Une bonne liste de la littérature mycologique est donnée.

THE BLACK YEASTS, II: MONILIELLA AND ALLIED GENERA, par G.S.DE HOOG édit., Studies in Mycology n° 19, 90 p., 30 figs., 22 phot. b.n., 8°, broché, 29 déc. 1979. Centraalbureau voor Schimmelcultures, Baarn, Nederland. Prix HFL 25,-.

Ce fascicule est composé de 7 articles centrés sur l'étude des trois mêmes genres de champignons levuriformes, *Moniliella, Trichosporonoides, Hyalodendron.* D'abord, De Hoog revoit la taxonomie de ces trois genres. *Moniliella suaveolens* et *M. acetoabutens* y sont reconnus et redécrits, tandis que *M. tomentosa* et *M. tomentosa* var. *pollinis* sont repris comme *M. suaveolens* var. *nigra.* L'auteur y décrit une forme nouvelle de sporulation à conidies échinulées. Deux nouvelles espèces *Trichosporonoides madida* et *T. spathulata* y sont décrites comme nouvelles et l'espèce type *Hyalodendron lignicola* redécrite. La comparaison de la conidiogénèse chez les trois genres montre une conidiation complexe chez *Moniliella:* blastique caténée acrogène avec ramification latérale acropète, ou arthrothallique rétrogressive, tandis qu'une conidiation blastique caténée acrogène apparait latéralement en succession basipète. L'ultrastructure de représentants de ces trois genres y montre des septa à dolipores, prouvant ainsi leur appartenance aux Basidiomycètes. L'étude auxanographique de l'assimilation et la fermentation des sucres, l'assimilation du nitrate, l'hydrolyse de l'urée et du besoin en vitamines , de même que l'analyse des composés organiques volatils et des carbohydrates cellulaires (monosaccharides et polyols) montrent bien les similitudes de ces genres.Dans un essai de systématique, De Hoog place *Moniliella* et *Trichosporonoides* aux confins des Basidiomycota, au voisinage des Dothideales (Ascomycota) et *Hyalodendron* dans une position plus éloignée des Ascomycètes. Nous trouvons dans cette étude un exemple d'utilisation convergente des techniques modernes dont dispose aujourdhui la mycologie systématique.

MUSHROOMS AND TOADSTOOLS, A FIELD GUIDE, par Geoffrey KIBBY, illustré par Sean MILNE, 256 p., nbr. figs., 100 pls. coul., 8°, broché, 1979.Oxford University Press, Walton street, Oxford OX2 6DP, UK. Prix net £ 4.95.

Tout mycologue sera sensible à l'attrait de ce livre, un de plus sans doute, mais bien différent des autres. D'abord, par le fait de son illustration composée d'aquarelles de champignons intégrées dans un dessin au trait figurant l'habitat (feuilles mortes, aiguilles, écorces, etc). Ensuite, ce livre se distingue des autres par le grand nombre d'espèces illustrées (403), dont près de la moitié ne l'ont pas ou sinon rarement été jusqu'à présent dans des ouvrages de ce genre. Cette entreprise de l'auteur et de l'artiste est audacieuse et d'autant plus louable qu'elle permettra au mycologue de terrain de se familiariser à vue avec un plus grand nombre d'espèces. Après une bonne introduction, l'auteur propose dix clés dichotomiques illustrées de dessins, basées, d'abord, sur la forme extérieure des fructifications, ensuite, dans le cas des champignons à lamelles, sur la couleur de la sporée. Je redoute les clés dichotomiques qui, comme les labyrinthes, vous conduisent par un trop long chemin, marqué de plus d'échecs que de succès, au nom du taxon (parfois très commun) que vous recherchez. J'eus espéré que les illustrations des clés en eut accéléré l'usage, mais l'auteur n'exploite pas l'image dans ce but. De plus, il oblige le récolteur à observer la couleur de la sporée en laboratoire avant de pouvoir user de la clé des champignons à lamelles. Les descriptions sont bonnes mais de valeur inégale. Les couleurs vues par l'artiste ne sont pas toujours celles décrites dans le texte. La prudence s'impose donc. Les aquarelles sont numérotées pour référer aux descriptions données en vis-à-vis où à la page suivante. Des erreurs sont à signaler: p.77 lire 3 et 2 au lieu de 2 et 3, p.129 lire 1,2,3 au lieu de 2, 3 et 4. L'écriture par l'artiste du nom de l'espèce près de chaque aquarelle eut été de loin préférable à la numérotation. Malgré ces quelques imperfections, ce livre sera certainement très apprécié et souvent consulté.

MYXOMYCETES, par Maurice CHASSAIN, Fascicule 1,144 p., 16 figs, 44 phot. coul. , 44 phot. b.n., 4°, reliure amovible, 29 août 1979. Ed. P. Lechevalier, 19 Rue Augereau, 75007 Paris. Prix net reliure et fascicule 1: 500 FF.

L'auteur, mycologue passionné de macrophotographie, s'est intéressé aux myxomycètes sur lesquels aucun ouvrage n'a été publié en France depuis Pouchet (1927), et entreprend ici la publication d'une flore illustrée des Myxomycètes de France, par livraisons successives. Cette première livraison comprend la reliure du tome I (farde à anneaux) et les 72 premiers feuillets (144 p.). 24 feuillets (48 p.) sont consacrés à l'introduction; les 48 autres à la description illustrée de 16 espèces (à raison de 3 feuillets par espèce, 5 p. de texte et figures et 1 p. blanche). Chaque espèce est illustrée d'abord par 2 ou 3 photographies en couleurs de 6x9 cm, au grossissement 20 x, de 3 ou 4 photographies blanc-noir au SEM (gross. 1000 à 10000 x)et d'une figure au trait. Les illustrations couleurs sont de très bonne qualité et témoignent d'une haute technicité; les illustrations SEM sont parfois de moindre qualité. Les figures au trait, ne représentant qu'une seule spore et un petit fragment du capillitium, sont rudimentaires et de très médiocre qualité. Le texte, voulu sans raison "très aéré" donne une synonymie sans références, l'habitat, l'affinité taxonomique, les périodes de récolte (en un trop grand tableau) et les caractères macro- et microscopiques. Ce texte d'ailleurs très succint aurait pu tenir en une seule page. La reliure à anneau doit permettre le classement taxonomique ou alphabétique des espèces au fur et à mesure de la parution de l'ouvrage. Si au premir abord on est frappé par la qualité de la photographie en couleurs, on sera aussi vite déçu par la pauvreté scientifique du texte, les dessins sans valeur, le choix malheureux de certaines photos SEM, les espaces "blancs" inutiles, une reliure très peu maniable et le prix exorbitant. De plus aucune indication ne permet de connaître l'importance de l'ouvrage entier et son prix global.

ICONES MYCOLOGICAE, ou ICONOGRAPHIE DES CHAMPIGNONS DE FRANCE PRINCIPALEMENT DISCOMYCETES, par Emile Boudier, Texte et 600 pls. polychrom.32x24 cm, Paris, 1905-1910. Réimpression par Sepia, Beaune, France. Editeur resp. Mr. R. Karger, 8 rue Jacques Briet, Saint-Remy, F-71000 Chalon-sur-Saône, France. Prix: environ 4000 FF (700 FF à la souscription, 600 FF à chacune des 5 livraisons et un solde d'environ 300 FF). Non relié. Texte broché seulement.

Les "*Icones Mycologicae*" d'Emile Boudier sont "l'ouvrage le plus beau, le plus exact et le plus consciencieux qui ait jamais été publié en couleurs sur les champignons...", ainsi s'exprimaient en 1906 les critiques de l'époque, à propos de cette extraordinaire iconographie des Champignons de France, consacrée principalement aux discomycètes. Il fallut 5 ans à l'éditeur pour faire lithographier les 600 planches coloriées qui composent cette oeuvre de toute une vie (Boudier,1828-1920) et 125 exemplaires seulement en furent tirés. Aujourdhui, convaincus de l'importance de l' oeuvre pour la mycologie moderne,Messieurs Roy et Karger, président et vice-président de sociétés mycologiques françaises, rééditent, sans profit, l'ouvrage de Emile Boudier, grâce à la mise au point d'un procédé spécial de photogravure Offset par la maison Sepia de Beaune. La réimpression demandera un minimum de deux années. Cette réimpression est offerte à la souscription des mycologues, sans but lucratif, c'est-à-dire au prix coûtant.Il n'en sera tiré que 650 exemplaires numérotés. Tant qu'on a pas eu en mains cet ouvrage exceptionnel, qui stupéfie à la fois les bibliophiles et les scientifiques les plus avertis, il est impossible d'imaginer la beauté de ces illustrations, la précision des détails microscopiques et l'exactitude des coloris. La comparaison des planches échantillon (que l'on peut obtenir pour 20FF) avec l'édition originale nous a convaincu de la haute qualité de cette réimpression. Il est exceptionnel de voir un tel ouvrage mis à nouveau à la portée de chacun par l'entreprise généreuse de quelques uns. L'ouvrage ne peut être obtenu que par souscription. L'impression ne se fera qu'après clôture de la souscription. Il importe que les institutions soucieuses du développement de la mycologie et les mycologues eux-mêmes fassent l'effort de donner à cette oeuvre mycologique la place qui lui revient partout à travers le monde.

PACIFIC SCIENCE ASSOCIATION. XIV PACIFIC SCIENCE CONGRESS, USSR, KHABAROVSK, AUGUST 1979, COMMITTEE H . FUNGI,VIRUSES, BACTERIA AND LICHENES, COMPONENTS OF ECOSYSTEMS OF THE PACIFIC REGION, by S.S. KHARKEVICH, édit., 55 p., 12°, broché, Moscou 1979. Prix. R. 27.-

Le texte comprend les résumés de 29 communications présentées à ce congrès international des sciences, concernant la microflore des régions orientales de l'Union soviétique en bordure du Pacifique.

CRYPTOGAMIE-MYCOLOGIE, CRYPTOGAMIE-ALGOLOGIE, CRYPTOGAMIE-BRYOLOGIE ET LICHENOLOGIE, nouvelles séries, Tome I, fasc. 1, 1980. Laboratoire de Cryptogamie, Museum d'Histoire naturelle, 12 Rue de Buffon, 75005 Paris. Prix d'abonnement à chaque série, 190 FF pour l'étranger, aux trois séries 570 FF.CCP Paris 4481-43.

La *Revue de Mycologie*, la *Revue Algologique* et la *Revue Bryologique et Lichénologique* du Laboratoire de Cryptogamie du Museum National d'Histoire Naturelle de Paris ont fusionné leur édition sous le même intitulé principal *Cryptogamie*, dont elles formeront les trois sections. La revue de chaque section commence une nouvelle série (Tome 1, fasc. 1) dès 1980 et publiera 4 fascicules par an. Les chercheurs de tous pays sont invités à y faire publier leurs travaux, dans la langue de leur choix, après accord de comités de lecture spécialisés - de réputation internationale. La haute qualité de la publication restera inaltérée.

BULLETIN ANNUEL DE LA FEDERATION CENTRE-EST [DE FRANCE] D'HISTOIRE NATURELLE ET DE MYCOLOGIE, édité par R. Farichon, N°1, 48 p., 4 figs. 5 phot. couls. 8°, 1979. Les Presses jurassiennes, 80 rue Mont Roland, 39001 Dole-du-Jura, France. Prix du n° 1: FF 15,-.

La *Fédération du Centre-Est d'Histoire naturelle et de Mycologie*, sous la présidence d'honneur de M. G. Becker, mycologue français bien connu, regroupe 12 sociétés régionales de naturalistes et de mycologues des départements français du Jura et de l'Ain. Après un éditorial de R. Farichon et la réponse donnée par G. Becker à la question *Pourquoi la Mycologie?* le lecteur trouvera un relevé illustré de 60 Myxomycètes de l'Ain, une récolte de *Gyromitra parma*, une étude de *Xanthochrous obliquus*, une étude de la mycoflore des tourbières et une étude de la position taxonomique de *Dermoloma intermedium* Bon et des Derlomataceae.

Ce bulletin est intéressant par la qualité de son contenu et sa bonne présentation. Sa périodicité future n'est pas annoncée encore. Il est certainement souhaitable que cette belle entreprise se poursuive, se développe et puisse, par sa qualité et sa régularité, trouver la large diffusion qu'elle mérite.

ALTERNATIVE MYKOLOGIE, édité par Jürgen LEHMANN. Vol. 1, n°1, 36 p. 1980-1981 (sic) 12°. Verlag Alternative Mykologie, An der Leite 66, D-8702 Rossbrunn, BR Deutschland. Abonnement: DM 12.- par n°, net.

L'éditeur, J. Lehmann, est le seul auteur publiant, dans ce premier numéro, un seul article sur les champignons des termitières. Il y exprime son opinion personnelle sur tous les travaux antérieurement publiés sur les champignons des termitières. Le graphisme illustrant la couverture de ce journal semble bien indiquer sa destination de publier les études des champignons termitophiles de l'éditeur.

SYSTEMATIC BOTANY, PLANT UTILIZATION AND BIOSPHERE CONSERVATION. by Inga HEDBERG ed., Proceedings of the Symposium in Commemoration of the 500th Anniversary of the University of Uppsala, 159 p., bound 1979, Amquist & Wiksell International, Gamla Brogatan 26, POB 62, S-10120 Stockholm. Price Sw.kr. 98.-.

Not specifically dealing with fungi but with general systematic Botany, the Symposium emphasized the new trends of systematic Botany and its objectives in the near future. Because of its involvement in agriculture and in medecine, systematic Botany will assume responsabilities in the comprehensive planification towards apparently opposite objectives of Plant Conservation and Plan exploitation.

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ERRATUM, VOLUME TEN

Page 511, line 11: *for* M. Haines *read* H. Haines

ERRATA, VOLUME ELEVEN

Page 5,	line 10:	for helminthospora read helminthosporus
8	10:	for helicospora read helicosporus
35	42:	*for* stoma *read* stoma
189	15:	for *singerinus* read *singerianus*
209	28:	for *pteriodophylla* read *pteridophylla*
214	24:	for *Dasyscypha* read *Dasyscyphus*
298	2:	*for* APHIDIS *read* NEOAPHIDIS
352	28:	for *Menosporopsis* read *Menisporopsis*
378	12:	for *nivius* read *niveus*
385	19:	*for* was *read* were
386	7:	*for* 1.I.1801 *read* 1.I.1821
445	30:	for *C.* read *Chaetosphaeria*

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A SYNOPSIS OF THE ORDERS AND FAMILIES OF PLECTOMYCETES WITH KEYS TO GENERA[1]

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SUMMARY

A synopsis of six orders, including 12 families of Plectomycetes is presented. The Ophiostomatales and Pithoascaceae are described as new, and the Ascosphaeriales, Eurotiales, Microascales, Onygenales, Chadefaudiellaceae, and Dendrosphaeraceae are validated. Keys to 90 plectomycete genera and an annotated list of nonplectomycete genera are provided.

Attempts to present systems of classification that reflect natural relationships have resulted in numerous changes and realignments of taxa in the Ascomycetes. Many of the pertinent systems have been reviewed by Nannfeldt (1932), Luttrell (1951), and Ainsworth *et al.* (1973).

A system that has had perhaps the greatest impact upon our concepts of the Plectomycetes is that of Nannfeldt (1932) in which he recognized three major groups of Euascomycetes: Plectascales, Ascohymeniales, and Ascoloculares. The Plectascales were characterized as having free ascogonia and antheridia which, along with the ascogenous hyphae, are soon surrounded by sterile mycelium. In simpler taxa the ascocarp forms a ball or maze of hyphae within which the asci are scattered irregularly. In more complex forms a firm, more complicated peridium develops which contains loose mycelium with scattered, globose asci. Included are both ostiolate and nonostiolate forms. Although the ostiolate taxa were traditionally placed in the Pyrenomycetes, Nannfeldt believed that a centrum with globose, irregularly disposed, deliquescent asci showed greater affinities to simpler cleistothecial families. He included cleistocarp-

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ous Gymnoascaceae and Aspergillaceae, and perithecial Ophiostomataceae and Chaetomiaceae, in the Plectascales.

Evanescence or deliquescence of asci in the Chaetomiaceae led Nannfeldt (1932), Miller (1941, 1949), and Gäumann (1949) to consider the hymenial taxa among the Plectomycetes. Cleistothecial taxa such as the Coronophorales (von Arx and Müller, 1954) and the Erysiphales and Meliolales (Miller, 1941, 1949) also have been placed here, although Luttrell (1951) notes that all clearly have either hymenia or basal tufts of asci. The irregular disposition of asci led Miller (1949) to conclude that the Myriangiales also belonged in the Plectomycetes. Luttrell (1951), however, emphasized the stromatic ascocarp, lysigenous development, and bitunicate asci and he placed the Myriangiales in the Loculoascomycetes. Ascus arrangement in the Elaphomycetales led Hawker (1954), Luttrell (1951), Wehmeyer (1975), and Alexopoulos and Mims (1979) to consider them Plectomycetes, while others have accepted them as specialized Tuberales (Martin, 1961; Ainsworth, 1971; Fennell, 1973; Korf, 1973).

The Ascosphaerales remain an anomaly. As reviewed by Fennell (1973), these fungi have been shifted between the Hemiascomycetes and Plectomycetes. The extremely reduced ascocarp is comparable only to that of *Monascus* while the ascogenous system and resulting asci are somewhat similar to those produced by some members of the Ophiostomataceae.

While the systematic treatments of Winter (1887), Lindau (1897), and Gäumann (1928) placed all cleistothecial ascomycetes either in the Plectascales or Perisporiales, later workers (Miller, 1949; Luttrell, 1951; von Arx and Müller, 1954) assigned most Perisporales to the Ascohymeniales. The Plectascales or Plectomycetes, as a result, came to be recognized for a time as a stable group of fungi.

Cain (1956b) appears to be one of the first to question relationships within the Plectomycetes. He stated "It is becoming increasingly evident that the taxa Plectascales and saprophytic Perisporiales do not represent natural orders or even a few related groups but a miscellaneous assemblage of a large number of phylogenetically unrelated taxa in which the ascocarps produce ascospores no longer adapted to aerial dispersal by being forcibly discharged into the atmosphere." He concluded that the cleistothecial type of ascocarp was the result of a progressive evolution away from dispersal of ascospores by means of air currents immediately following their production (*i.e.*, typical of that of most Ascohymeniales and Loculoascomycetes). This pattern of evolution has resulted in a modification in ascal arrangement, a shortening of asci, a loss of paraphyses, and other ascocarp changes. The theory that cleistothecial ascomycetes were derived from Pyrenomycetes and Discomycetes has been followed by Cain and Malloch in subsequent publications on the subject (see Malloch, 1979). Malloch believes that cleistothecial ascomycetes were derived from four major taxonomic groups: (1) Pleosporales, (2) Diaporthales, (3) Hypocreales, and (4) Pezizales or other operculate Discomycetes (Malloch, 1979).

Today there exist two extremes in the classification of Plectomycetes, one in which only the single order Eurotiales is accepted (Fennell, 1973; von Arx, 1974b), and another in which the plectomycetous genera are distributed among 19 families of Pyrenomycetes, Discomycetes, and Loculoascomycetes (Malloch, 1979). Fennell (1973) recognized the following families of EUROTIALES: Amorphothecaceae, Cephalothecaceae, Eurotiaceae, Gymnoascaceae, Monascaceae, Onygenaceae, Pseudeurotiaceae, Thermoascaceae, and Trichocomataceae (sic). These taxa were distinguished largely on peridial types and their associated anamorphs. The novel approach of Malloch (1979) included the following arrangement of families: DIAPORTHALES--Cephalothecaceae, Chaetomiaceae, Coniochaetaceae, Endomycetaceae, Melanosporaceae, Microascaceae, Pseudeurotiaceae, Sordariaceae, and Xylariaceae; HYPOCREALES--Nectriaceae and Trichocomaceae; PEZIZALES--Ascobolaceae, Monascaceae, Onygenaceae (incl. Gymnoascaceae), and Pyronemataceae; and PLEOSPORALES--Eremomycetaceae, Phaeotrichaceae, Sporormiaceae, and Zopfiaceae.

The taxonomic characters relied upon most heavily by Malloch include ascocarp initials, types of mycelium, ascocarp morphology, presence or absence of paraphyses, ascus structure and formation, ascospore structure, pigmentation, microchemistry, and the presence and type of anamorph. In most of Malloch's studies only mature ascocarps grown in culture or herbarium material were studied.

We agree in general with the concept put forward by Cain and Malloch that cleistothecial ascomycetes should be distributed among a great number of families. In our opinion one of the most useful characters employed in placing a number of these families in their proper order is that of centrum development. The "Cain-Malloch hypothesis" ignores the centrum as a valid characteristic. Yet in the analysis of development in various taxa of Plectomycetes one can see a number of modifications in the centrum, even though in essentially all of these fungi the asci ultimately become globose, evanescent or deliquescent, and irregularly disposed. This makes the taxon, in the traditional sense, a plectomycete. The ontogenetic pathways through which various taxa reach this point are highly diverse. Members of *Ceratocystis*, *Sphaeronaemella*, and *Faurelina* bear asci from a basal hymenium (Parguey-Leduc, 1977). As the ascogenous hyphae ramify upward, asci differentiate, and by a basal dissolution become free within the centrum. A similar phenomenon appears to take place in *Ascosphaera* (Spiltoir, 1955; Spiltoir and Olive, 1955) in which the asci are freed within the liquid of the nutriocyte, while in *Monascus* the asci also deliquesce.

Members of the Microascaceae appear to have evolved away from a hymenial configuration. In the microascaceous centrum a peripheral layer of paraphysoidal elements develops that grows inward toward the ascogenous hyphae. The manner in which the ascogenous hyphae ramify and form asci among these elements differs in the genera of the Microascaceae. The most hightly evolved ascogenous system, and that most typical of the Plectomycetes, is exemplified in the Eurotiales. The centrum of the eurotiacean fungi is completely filled with vegetative cells of various types and arrangements within which the ascogenous hyphae ramify, differentiate, and develop asci at several levels. These vegetative hyphae will remain in some taxa as a maezaedium or capillitium.

We agree that there is sufficient evidence presented to justify the transfer of a number of taxa to different orders of the Ascohymeniales or Loculoascomycetes (Malloch, 1979), but in other instances the evidence is too fragmented and superficial. More data must be obtained on centrum ontogeny, types of ascogenous systems, septal ultrastructure, fine structure of ascospores and asci, and microchemistry of ascospores, ascus walls, and peridium before we can go beyond the point of speculation about evolutionary lines. We concur with the general feeling that the Plectomycetes represent an artificial assemblage of taxa. With current evidence, however, most taxa can be delt with more accurately using an ordinal framework that expresses intermediate evolutionary changes. The centrum provides this framework. At least six orders have been recognized that develop a plectomycete centrum. They include the Ascosphaerales, Elaphomycetales, Eurotiales, Microascales, Onygenales, and Ophiostomatales. In the following pages we characterize these orders, attempt to justify their retention, and provide our views on their relationship to other Ascomycetes. The following key may be used to distinguish them:

KEY TO THE ORDERS OF PLECTOMYCETES

A. Centrum composed of vegetative hyphae or cells within which ascogenous hyphae ramify and differentiate; asci globose, evanescent, borne at all levels; interstitial hyphae sometimes forming a capillitium or mazaedium..B

  B(A). Ascocarps hypogeal, mycorrhizal, usually large (0.5-5 cm)........ELAPHOMYCETALES (p. 6)

  BB(A). Ascocarps not as above........................C

    C(BB). Peridium lacking, or if present,of loose, interwoven hyphae; ascocarps nonostiolate, glabrous, tomentose, or with well developed appendages; racket hyphae often present; anamorphs arthro- or aleurioconidial...ONYGENALES (p. 8)

    CC(BB). Peridium present of various tissue types, appendages not highly differentiated, when present; anamorphs phialoconidial..............EUROTIALES (p. 23)

AA. Centrum develops from the proliferation of ascogenous hyphae borne in basal layers, tufts, columns, or ramifying outward among peripheral, filamentous, paraphysoidal cells; asci becoming scattered after basal dissolution, globose in youth, deliquescent with age..D

  D(AA). Ascogonial system simple, enlarged; ascocarps membranous or consisting of thin-walled interwoven hyphae; asci deliquescing early; ascospores enclosed in one or more sacklike membranes; anamorphs single or meristem arthroconidia......... ASCOSPHAERALES (p. 36)

  DD(AA). Ascogonial system complex; ascocarps more elaborate with peridia of several layers........................E

E(DD). Ascospores usually dextrinoid when young, with one, two, or no germ pores; asci usually catenulate; centrum initiated by paraphysoidal hyphae; ascocarps with or without beaks or ostioles; walls of beaked taxa cellular..............MICROASCALES (p.40)

EE(DD). Ascospores not dextrinoid, without germ pores; centrum of pseudoparenchymatous cells; asci not catenulate; ascogenous hyphae arise from basal layers, central columns, or tufts; ascocarps ostiolate or not, beaks, when present, composed of parallel hyphae, usually relatively long.............OPHIOSTOMATALES (p.48)

ELAPHOMYCETALES Trappe, Mycotaxon 9: 330. 1979.

Ascocarps hypogeal, globose, up to 5 cm in diam, variously colored, smooth or ornamented, often tomentose and ensheathed by proliferated ectomycorrhizae of associated plants. Peridium variously textured, composed of up to three layers: outer peridium or crust flaking off at maturity; cortex hard, usually broken into cones or pyramids; and inner peridium fleshy. Gleba a single cavity, hollow at first but soon becoming stuffed with ascogenous hyphae and sterile filaments, powdery with ascospores and, in some species, a capillitium. Asci globose, four- to eight-spored, formed directly from the ascogenous hyphae, nonamyloid, evanescent. Ascospores globose, pigmented, ornamented. Anamorph: *Cenococcum graniforme* (Sow.) Ferd. & Winge reported for some *Elaphomyces* spp.

One family: Elaphomycetaceae Tul., Fungi Hypog., p. 100. 1851, with only a single genus included: *Elaphomyces* Nees *ex* Fr. Type: *E. granulatus* Fr., Syst. Mycol. 3: 58. 1829. About 30 spp. are known (see Dodge, 1929; Kobayasi, 1960; Hawker *et al.*, 1967, for descriptions of some spp.).

Discussion: Because of their hypogeal, mycorrhizal habit, ascocarp size and shape, Elaphomycetaceae have been considered to be specialized Tuberales (Fennell, 1973; Korf, 1973). As noted earlier, however, the deliquescent, irregularly arranged asci led others to consider them to be related to the Plectomycetes. Trappe (1979) felt that because their relationships to the Tuberales or Pezizales are equally unsatisfying, they deserve recognition as a new order. We agree with this disposition of the family because it equally does not relate to other plectomycetous taxa. When one considers the habitat, ascocarp size, and manner of spore dissemination, one might conclude a closer relationship to the Tuberales. Perhaps the irregular disposition of asci resulting from the loss of a hymenium might be equated to a similar condition in the Basidiomycetes typified by the Lycoperdales. The end point of evolution in one gasteromycete line terminates in the Lycoperdales, a similar situation might exist in the Pezizales-Tuberales-Elaphomycetales complex. Even though the ascus of *Elaphomyces* is thought to evanescent, it has been observed in *E. granulatus* (Hawker, 1968) and in *E. persoonii* Vitt. (pers. observ.) that the ascal walls remain persistent until late in ascosporogenesis. Using SEM, one observes that asci of *E. persoonii* appear to tear along a preformed line of dehiscence, whereas in *E. granulatus* the ascal wall disintegrates in a multiperforate pattern. No obvious line of dehiscence has been detected, however, in ultrathin sections of the ascal walls observed recently, using the transmission electron microscope (D.A. Samuelson, pers. comm.), of *E. persoonii*. The ascocarp wall of *Elaphomyces* appears unique, although its thickness and consistency are much more like the Tuberales than those of any of the Plectomycetes. Spore size and ornamentation also relate more closely to those of the Tuberales.

Many, if not all, species of *Elaphomyces* are ectomycorrhizal on species of *Picea*, *Pinus*, and *Quercus*. Other associations with *Vaccinium* and the fern genus *Osmunda* are suspected (pers. observ.).

The anamorph of *Elaphomyces* was thought to be *Cenococcum graniforme* (Trappe, 1964) and later confirmed (Trappe, 1971). The unique hyphal arrangement in the mycorrhizal mantle of *Cenococcum* is identical to that of the peridial cells of *Elaphomyces* (Trappe, 1971; Trappe and Kimbrough, 1972). *Mesophellia*, a genus traditionally placed in the Elaphomycetaceae (Dodge, 1929), was found to be a basidiomycete and was transferred to the Mesophelliaceae (Lycoperdales) along with *Abstoma*, *Castoreum*, and *Radiigera* (Zeller, 1944). It is still included there (Dring, 1973). Clémencet (1932) proposed the genus *Ascoscleroderma* for the stipitate *Elaphomyces cyanosporus* Tul. Trappe (1979) notes that the "stipe" is merely an emphemeral, basal mycelial tuft and is unworthy of being used as a character to separate genera in the Elaphomycetaceae. He synonymized the two genera.

ONYGENALES Ciferri *ex* Benny & Kimbrough, *ord. nov.*

Onygenales Ciferri, *nomen nudum*, Atti Ist. Bot. Univ. Pavia, Ser. 5, 14: 239. 1957 (without Lating diagnosis; Art. 36).

Ascocarpi nonostiolati sessiles vel stipitati cum vel sine appendicibus; paries peridii laxus ex hyphis tenui vel crassitunicatis compositus; asci cum vel sine hamis, ovoidei vel subclavati, evanescentes, octospori; ascosporae nonseptatae, hyalinae vel late coloratae; anamorphoses ex aleurioconidiis vel arthroconidiis constantes; saepe keratinophilus.

Ascocarps nonostiolate, sessile or stipitate, with or without appendages; wall of peridium lax, composed of thin- or thick-walled hyphae; asci with or without croziers, ovoid or subclavate, evanescent, eight spored; ascospores nonseptate, hyaline or bright colored; anamorphs consisting of aleurioconidia or arthroconidia; frequently keratinophilic.

We consider three families: Dendrosphaeraceae, Gymnoascaceae, and Onygenaceae.

Discussion: The phylogenetic relationships of the Onygenales have been the subject of much discussion and speculation in recent years. The three families that we include here have historically been placed in the Plectascales, Aspergillales, or Eurotiales. Recognition of the Onygenales as an order of Plectomycetes has not been generally followed and the relationship of these families to other groups of ascomycetes has not been clearly established. They are critical taxa for those who propose the origin of Ascomycetes from Zygomycetes or lower taxa (Bessey, 1950). They represent perhaps the end point of evolution for those who would derive the Ascomycetes from floridean algae (Demoulin, 1975). Cain (1956a) suggested that the

Gymnoascaceae may have evolved from the Aspergillaceae and the Aspergillaceae from the Hypocreales. Malloch (1970b) and Cain (1972) speculate that the Onygenaceae may have originated from certain operculate Discomycetes, and in a later paper the family (Onygenaceae incl. Gymnoascaceae) was placed in the Pezizales (Malloch, 1979).

Although the production of sessile versus stipitate ascocarps was classically used to separate members of Gymnoascaceae from the Onygenaceae, Malloch and Cain (1970a, 1971a) placed both stipitate and sessile taxa in their version of the Onygenaceae. Redhead and Malloch (1977) further expanded their concept of the Onygenaceae when they included *Galactomyces*, a genus that lacks an ascocarp.

We disagree with the transfer of the Onygenales to the Pezizales. While the criteria used by Malloch (1970b), *i.e.*, colorless mycelium, lack of phialides, colorless ascospores, and spores without germ pores might be used as evidence to support a theory of evolution, they are not adequate data for use in trying to establish an oridnal relationship. Aside from the unique mechanism of ascospore release through an operculum, Pezizales have a number of other features that make them stand apart from the Onygenaceae. Anamorphs of Pezizales, when they occur, are blastoconidial, not aleurio- or arthroconidial. Cleistocarpy is extremely common among Pezizales. In all of these pezizalean taxa, however, the asci have remained persistent and retained an apical operculum or a modified operculum. The Tuberales, which most agree evolved from the Pezizales, have retained persistent asci and often a hymenium, even though they have lost their active mechanism of spore discharge. While the Onygenales and Pezizales are similar in having colorless ascospores without germ pores (although many species of the Pezizales have pigmented ascospores), spore size, shape, and ornamentation appear quite different in members of the two orders. Both groups usually have naked ascogonia, yet those of Pezizales are often large, beaded coils with trichogynes, not small, intertwined pairs as is common in Onygenales. Although aedquate data are available, there are suggestions at the ultrastructural lavel that ascosporogenesis is different in members of the two orders (Beckett *et al.*, 1974; Hill, 1975).

Several members of the Pezizales, for example *Ascodesmis*, appear highly reduced and form only a remnant of excipulum. It is likely that certain of the Arachnioideae (Gymnoascaceae) represent greatly reduced members of the Pezizales, and in fact point to one of the evolutionary pathways. However, until more data are available, we are unwilling to merge the two orders. As particular species and genera are studied critically, transfers from the Onygenales to the Pezizales, or the reverse, may be necessary. We anticipate, however, that there are numerous taxa in which adequate links will never be established, and these fungi will be retained in the Onygenales.

KEY TO THE FAMILIES OF ONYGENALES

A. Ascocarps relatively small (mostly less than 2 cm long), mostly sessile, some stipitate or elevated on a hyphal tuft........................B
    B(A). Ascocarps with a completely closed peridial wall (a true cleistothecium), one to several cells thick...........Onygenaceae (p.10)
    BB(A). Ascocarps not completely closed, peridium of loosely interwoven hyphae that in some cases is highly differentiated and thick walled....Gymnoascaceae (p.15)
AA. Ascocarps large (up to 17 cm long), producing a basal rhizoid and apically branched, with each branch bearing an irregularly shaped receptacle; stipitate..Dendrosphaeraceae (p.22)

Onygenaceae Fr., Summ. Veg. Scand. 2: 446. 1849.

Ascocarps variously shaped, stipitate or sessile, hyaline or light colored, never dark brown or black, glabrous to hairy or tomentose, nonappendaged or variously appendaged, nonostiolate, frequently highly variable within a collection, arising from ascocarp initials that are either prominant coils or swollen cells. Asci subglobose to globose, irregularly disposed, nonstipitate, evanescent, usually arising from prominent croziers. Ascospores one-celled, hyaline to brightly colored, never dark, variously shaped, often oblate, always lacking germ pores, smooth to roughened or ridged, with equatorial ridges in some. Anamorphs produced as aleurioconidia or arthroconidia. Conidia hyaline, one to several celled, smooth or roughened. Frequently occurring on keratinous substrates, also on plant debris or soil.

Type genus: *Onygena* Pers. *ex* Fr. Fourteen genera accepted.

Discussion: The family Onygenaceae was revised by Boedijn (1935a) to include three monogeneric subfamilies of stipitate Plectomycetes (Dendrosphaeroideae--*Dendrosphaera;* Onygenoideae--*Onygena;* and Trichocomoideae--*Trichocoma*). Ciferri (1957) later raised these taxa in rank, the Onygenaceae to Onygenales and the three subfamilies to family status. Kobayasi *et al.* (1959) cultured *Onygena corvina* Alb. & Schw. *ex* Fr. but they were unable to induce ascocarp formation. The discovery of an arthroconidial anamorph, however, led them to believe that *Onygena* was not related to *Trichocoma* and *Penicilliopsis*. Malloch and Cain (1970a) disregarded the stipitate nature of the ascocarp as a good family character and placed *Arachnomyces* in the Onygenaceae. In their monograph, Malloch and Cain (1971a) considered Onygenaceae to be cleistocarpous Gymnoascaceae which produced arthroconidial or aleurioconidial anamorphs and were often keratinophilic. They included *Aphanoascus*, *Arachnomyces*, *Dichotomomyces*, *Onygena*, *Thermoascus*, and the new genera *Ascocalvatia* and *Xynophila* in the enlarged family. They considered both *Anixiopsis* and *Keratinophyton* to be synonyms of *Aphanoascus*. De Vries (1969), Udagawa and Takada (1973), and von Arx (1974b) maintain *Anixiopsis* as a separate genus. *Pleuroascus*, a fungus not reported since its original description by Massee and Salmon (1901), was redescribed from culture by Malloch and Benny (1973) and placed in the Onygenaceae because of ascocarp characters and an arthroconidial anamorph. We disagree with the broader concept of *Pleuroascus* proposed by Lodha (1978).

Von Arx and Samson (1973) described two monotypic genera, *Xanthothecium* and *Leucothecium*, the latter possessing an arthroconidial anamorph and other features of the Onygenaceae. Although the type of *Xanthothecium*, *X. peruvianum* (Cain) v. Arx & Samson was placed in *Arachnomyces* (Malloch and Cain, 1970a) it appears to be more closely related to *Anixiopsis*, *Keratinophyton*, and *Leucothecium*. Another monotypic genus, *Neoxenophila*, based on *N. foetida* Apinis & Clark (1974), was isolated from rodent hair, and although it is unusual in being heterothallic, it is included in the Onygenaceae because of its close similarity to *Aphanoascus* and *Xynophila*. We also include two other genera, *Diehliomyces* (Gilkey, 1954) and *Xylogone* (von Arx and Nilsson, 1969) in the family. Although *Xylogone* produces dark ascocarps, atypical of the Onygenaceae *sensu* Malloch and Cain, it does possess the characteristic arthroconidial anamorph. *Anixiopsis* also produces dark ascocarps. *Diehliomyces* is a parasite in commercial mushroom beds and has large ascocarps, often reaching 3 cm in diam, a feature that led Diehl and Lambert (1930) to describe it as a species of *Pseudobalsmia* (Tuberales *sensu* Korf, 1973). Gilkey (1954) proposed *Diehliomyces* for the single species, *D. microsporus* (Diehl & Lambert) Gilkey, and placed it in the Eurotiales close to the Gymnoascaceae because of its peridium of interwoven hyphae, evanescent asci, and arthroconidia formed from peridial hyphae. Hawker (1959) agreed with Gilkey and thought that *Diehliomyces* might be intermediate between the Gymnoascaceae and the Elaphomycetaceae because of the crustlike peridium. Although they are comparable in size, the multilayered peridium of *Elaphomyces* (Dodge, 1929; Kobayasi, 1960) is distinctly different from the interwoven hyphal wall of *Diehliomyces*.

Redhead and Malloch (1977) described the yeastlike genus *Galactomyces* based upon two species of *Endomyces*, *E. geotrichum* Butler & Peterson and *E. reessii* van der Walt. The genus was placed in the Onygenaceae because the species produced arthroconidia and the ascospores possessed equatorial grooves. Their concept of the Onygenaceae was expaned from that of Malloch and Cain (1971a) to include members of the Gymnoascaceae (see Malloch, 1979). We do not accept Redhead and Malloch's placement of *Galactomyces*, but concur with von Arx (1977a) in transferring both species to the emended genus *Galactomyces*. *Dipodascus aggregatus* Francke-Grosmann has been shown to produce multiperforate septa (Kreger-van Rij and Veenhuis, 1974). Members of the Onygenaceae should produce centrally perforate septa with associated Woronin Bodies typical of other ascomycetes (Gull, 1978). The anamorph of *E. geotrichum* (*Geotrichum candidum* Link *ex* Pers.) has also been shown to produce multiperforate septa (Steele and Fraser, 1973), a feature supportive of von Arx's scheme. An arthrosporic anamorph is also characteristic of species of *Dipodascus*. *Dipodascus uninucleatus* Biggs was removed from the genus and placed in *Dipodascopsis* (Batra, 1978). This genus (of uncertain affinities according to von Arx *et al.*, 1977) lacks an anamorph, produces typical ascomycete septa (Kreger-van Rij and Veenhuis, 1974), and has a different physiology and cell wall composition (Weijman, 1977), data again that support von Arx's concept of these taxa. Our views on the relationship of the Gymnoascaceae are discussed later, but we feel that genera of the two families should not be combined into a single taxon.

KEY THE THE GENERA OF ONYGENACEAE

A. Ascocarps relatively large (1-3 cm in diam); found only in beds of cultivated mushrooms, *Agaricus bisporus* (Lange) Singer..........*Diehliomyces*
Type species: *D. microsporus* (Diehl & Lambert) Gilkey, Mycologia 46: 790. 1954.
One species (see Diehl and Lambert, 1930; Hawker, 1959).

AA. Ascocarps smaller, rarely 5 mm in diam, often 1 mm in diam; habitat otherwise.......................B

B(AA). Ascocarps stipitate; on hooves, horns, claws, owl boluses, and other keratinophilic substrates.........*Onygena*
Type species: *O. equina* (Willd.) Pers. *ex* Fr., Syst. Mycol. 3: 207. 1829. Three species (Ward, 1899; Malloch, 1970b).

BB(AA). Ascocarps sessile; habitat variable...........C

C(BB). Ascocarps covered with a tomentum or bearing various types of appendages...............D

CC(BB). Ascocarps glabrous or nearly so...................H

D(C). Ascocarps under a dense tomentum...*Xynophila*
Type species: *X. mephitalis* Malloch & Cain, Can. J. Bot. 49: 845. 1971. One species.

DD(C). Ascocarps not under a dense tomentum, bearing appendages....................E

E(DD). Ascocarps covered with hyphalike appendages.........................*Dichotomomyces*
Type species: *D. cejpii* (Mil'ko) Scott, Trans. Brit. Mycol. Soc. 55: 314. 1970. One species (see Udagawa, 1970; Malloch and Cain, 1971a).

EE(DD). Appendages not hyphalike.........................F

F(EE). Ascocarp appendages tightly coiled..........................*Pleuroascus*
Type species: *P. nicholsonii* Massee & Salmon, Ann. Bot. (Lond.) 15: 330. 1901. One species (see Malloch and Benny, 1973).

FF(EE). Ascocarp appendages usually only curved to recurved, if coiled, only at the tips..........................G

G(FF). Ascospores oblate, reddish brown; anamorph not produced.....................*Arachnomyces*
Type species: A. *nitidus* Massee & Sal-

mon, Ann. Bot. (Lond.) 16: 68. 1902. Three species (see Malloch and Cain, 1970a).

GG(FF). Ascospores globose to ovoid or lenticular, hyaline to light brown; anamorph a *Chrysosporium*.................*Neoxenophila*
Type species: *N. foetida* Apinis & Clark, Trans. Brit. Mycol. Soc. 63: 263. 1974. One species.

H(CC). Ascospores cylindrical; centrum traversed by strands of sterile hyphae.........................*Ascocalvatia*
Type species: *A. aveolata* Malloch & Cain, Can. J. Bot. 49: 840. 1971. One species.

HH(CC). Ascospores not cylindrical; no sterile tissue within the centrum..................................I

I(HH). Ascospores with an equatorial rim or crest..J

J(I). Ascospores with an equatorial rim, hyaline to yellowish, lenticular, finely verrucose...............*Leucothecium*
Type species: *L. emdenii* v. Arx & Samson, Persoonia 7: 378. 1973. One species.

JJ(I). Ascospores with an equatorial crest, yellow-brown, oblate, smooth........................*Keratinophyton*
Type species: *K. terreum* Randhawa & Sandhu, Sabouraudia 3: 252. 1963. One species.

II(HH). Ascospores lacking equatorial wings or crests..K

K(II). Ascospores oblate.........................L

KK(II). Ascospores ovoid to ellipsoid............M

L(K). Ascospores yellowish, finely echinulate...........................*Xanthothecium*
Type species: *X. peruvianum* (Cain) v. Arx & Samson, Persoonia 7: 377. 1973. One species.

LL(K). Ascospores reddish brown, reticulate......*Anixiopsis*
Type species: *A. stercoraria* Hansen, Bot. Zeit. 7: 131. 1897. One species (see Udagawa, 1966; de Vries, 1969).

M(KK). Ascospores ovoid to ellipsoid, echinulate; thermophilic;

ascocarps yellowish brown.......*Thermoascus*
Type species: *T. aurantiacus*
Miehe, Die Selbst. Hues., p. 70,
1907. One species (see Apinis,
1967).

MM(KK). Ascospores sphaerical, smooth,
mesophilic; ascocarps dark..........*Xylogone*
Type species: *X. sphaerospora*
v. Arx & Nilsson, Svensk Bot.
Tidskr. 63: 345. 1969. One or
two species.

Gymnoascaceae Baranetsky, Bot. Zeit. 30: 158. 1872.

Ascocarps small, more or less globose, usually with variously shaped peridia which consist of anastomosing, branched or loosely interwoven, thin- or thick-walled, smooth, echinulate, or tuberculate hyphae. Appendages, when present, short or long, spirally coiled, ctenoid, straight, or uncinate. Asci irregularly disposed in the ascocarp, usually originating from croziers, globose to ovoid to clavate, eight spored, evanescent. Ascospores one-celled, small, globose, oblate or lenticular, smooth, rough or variously sculptured, usualy hyaline or lightly colored, seldom dark. Anamorphs arthroconidial or aleurioconidial. Habitat mostly on dung, plant debris, feathers, hair, or in soil; some species produce anamorphs that cause skin, lung, and other infectous diseases of man and other animals.

Type genus: *Gymnoascus* Baranetsky, Bot. Zeit. 30: 158. 1872. Twenty-four genera accepted.

Discussion: Taxonomy of the Gymnoascaceae has recently been a subject of controversy. Von Arx (1971a) reviewed the taxonomic status of the fungi in the family at that time. Up to 19 genera had been recognized: *Actinodendron*, *Ajellomyces*, *Apinisia*, *Arachniotus*, *Arthroderma*, *Auxarthron*, *Ctenomyces*, *Eidamella*, *Gymnoascus*, *Myxotrichum*, *Nannizzia*, *Narasimhella*, *Petalosporus*, *Pseudoarachniotus*, *Rollandina*, *Shanorella*, *Spiromastix*, *Toxotrichum*, and *Tripedotrichum*. Most of the genera were believed to have a good conceptual basis, but some such as *Actinodendron*, *Eidamella*, *Pseudoarachniotus*, and *Rollandina* were found to be synonyms of other genera. *Actinodendron* (Orr and Kuehn, 1963a) was based upon a mixture of *Oncocladium flavum* Wallr. and its conidia (Hughes, 1968). Ascospores were not present as described by Orr and Kuehn (1963a) and, therefore, the genus cannot be a member of the Gymnoascaceae. *Eidamella*, while recognized as a valid genus by Benjamin (1956a), was later treated as a species of *Myxotrichum* by Orr *et al.* (1963c). The remaining genera that were treated as doubtful by von Arx (1971a) were disposed as follows: *Pseudoarachniotus*, a synonym of *Arachniotus; Narasimhella* was thought to be a valid genus; and several species were transferred from *Pseudoarachniotus* and *Arachniotus* to *Amauroascus*. Von Arx also proposed three monotypic genera, *Arachnotheca*, *Byssoascus*, and *Eleutherascus*, based upon species previously described in *Arachniotus*. One species, *Eleutherascus lectardii* (Nicot) v. Arx, was later the basis for another monotypic genus, *Hemiascosporium spinulosum* Batra (1973), the type of the Hemiascosporiaceae of the Endomycetales. The similarity between *Eleutherascus* and *Hemiascosporium* was recognized by Huang (1975) who also noted its similarity to *Ascodesmus* (Pezizales). It is our opinion that *Eleutherascus* is a simplified, operculate discomycete, perhaps related to *Ascodesmus*.

Samson (1972) revised *Pseudogymnoascus* and *Gymnoascus* and listed the valid species in each genus. He also redefined the genus *Auxarthron* based on ascospore morphology, and not on the presence of swellings on the peridial hyphae at the septa as it was in the original definition (Orr *et al.*, 1963b).

In a reexamination of the Gymnoascaceae, von Arx (1977b) rearranged several genera described by Orr and coworkers (Ghosh *et al.*, 1963; Orr, 1976, 1977a, 1977b, 1977c; Orr and Kuehn, 1974a, 1964b; Orr, Ghosh, and Roy, 1977; Orr, Roy, and Ghosh, 1977; Roy *et al.*, 1978; Sigler and Carmichael, 1976). Von Arx (1977b) believed that species of the following genera formed the basis for several of Orr's taxa: *Disarticulatus*, *Petalosporus*, *Plunkettomyces* (based on species of *Arachniotus*); *Kuehniella* (based on a species of *Arachnotheca*); *Gymnascella*, *Gymnoascoideus*, *Macronodus*, *Tripedotrichum*, *Uncinocarpus* (based on species of *Gymnoascus*). *Rollandina* (Roy *et al.*, 1978) was thought by von Arx (1977b) to be a *nomen confusum*, based partly upon a species of *Nannizzia* (Benjamin, 1956a; Apinis, 1968). Utilizing mainly ascospore morphology, von Arx (1977b) recognized the following genera in the Gymnoascaceae: *Ajellomyces*, *Amauroascus*, *Arachniotus*, *Arachnotheca*, *Arthroderma*, *Auxarthron*, *Byssoascus*, *Ctenomyces*, *Emmonsiella*, *Gymnoascus*, *Myxotrichum*, *Nannizzia*, *Narasimhella*, *Pseudogymnoascus*, and

Shanorella. In his review of the family, however, he failed to mention *Pectinotrichum* (Varsavsky and Orr, 1977), although he had recognized it earlier as a valid taxon (von Arx, 1974b).

Recently, evidence was presented by McGinnis and Katz (1979) to support the conbination of the teleomorphs of *Blastomyces dermatitidis* Gilch. & Stolk (*Ajellomyces*: McDonough and Lewis, 1968) and *Histoplasma capsulatum* Darl. (*Emmonsiella*: Kwon-Chung, 1972) within the single genus *Ajellomyces*. *Renispora* is another gymnoascaceous taxon with a relatively small ascocarp and an anamorph similar to *Histoplasma capsulatum*. Most Gymnoascaceae produce anamorphs belonging to *Chrysosporium*, *Malbranchia*, or *Oidiodendron* (Sigler and Carmichael, 1976).

Keys to the genera of Gymnoascaceae expressing various taxonomic persuasions have been presented by von Arx (1971b), Fennell (1973), and Orr, Roy, and Ghosh (1977). We are following mainly the concepts of von Arx (1971b, 1977b) and Apinis (1964) in the keys presented below. Only a continued study of types, observing sporulation in pure culture, and establishing anamorph-teleomorph relationships will prove the accuracy of the American (Orr *et al.*) or the Dutch (von Arx *et al.*) systems of classification. Kendrick and DiCosmo (1979) have provided an excellent compilation of anamorph-teleomorph associations in the Ascomycetes.

KEY TO THE SUBFAMILIES OF GYMNOASCACEAE

A. Peridial hyphae more or less thin walled; many species strongly keratinophilic; appendages lacking or reduced; coils often present as peridium....................................B

B(A). Appendages lacking; peridial hyphae generally similar to the vegetative hyphae, inconspicuous or lacking; asci appearing naked.............Arachnioideae
Apinis, Mycol. Pap. 96: 4. 1964. (p.18)
Type genus: *Arachniotus* Schroet.
Six genera recognized.

BB(A). Appendages relatively inconspicuous, curved, coiled, elongate, slender, hyphal or of irregular cells, macroconidial; peridial hyphae disarticulating; many species keratinophilic; anamorphs

often causing infectious diseases of man and animals............Arthrodermoideae
Apinis, Mycol. Pap. 96: 4. 1964. (p. 19)
Type genus: *Arthroderma* Berk.
Six genera recognized.

AA. Peridial hyphae (at least out layer) thick walled and markedly different from vegetative hyphae; appendages often conspicuous, ctenoid, clavate, straight, hooked or branched vertically...........Gymnoascoideae
Apinis, Mycol. Pap. 96: 3. 1964. (p. 20)
Type genus: *Gymnoascus* Baranetsky
Six genera recognized.

KEY TO THE GENERA OF ARACHNIOIDEAE

A. Ascospores fusiform, elliptical to reniform or allantoid...B

AA. Ascospores not fusiform, but either spherical, lenticular or oblate................................C

B(A). Ascospores fusiform, with longitudinal ridges..............................*Byssoascus*
Type species: *B. striatisporus* (Barron & Booth) v. Arx, Persoonia 6: 377. 1971. One species (see Barron and Booth, 1966).

BB(A). Ascospores elliptical to reniform or allantoid, with pitted walls........*Renispora*
Type species: *R. flavissima* Sigler, Gaur, Lichwardt & Carmichael, Mycotaxon 10: 133. 1979. One species.

C(AA). Ascospores spherical............................D

CC(AA). Ascospores lenticular or oblate, often with an equatorial marking.......................E

D(C). Ascospores ornamented, reddish or brownish; asci from ascogenous hyphae; peridium lacking, but asci sometimes surrounded by hyphae...*Amauroascus*
Type species: *A. verrucosus* (Eidam) Schroet., *in* Cohn's Kryptogamen-Fl. Schleisens 3(2): 211. 1893. Five species (see von Arx, 1971b).

DD(C). Ascospores with thick walls, covered with a hyaline sheath, bluish or violet; asci borne on croziers; peridium of thick-walled, anastomosing hyphal filaments.........*Arachnotheca*

Type species: A. *glomerata* (Müller & Pracha-Aue) v. Arx, Persoonia 6: 376. 1971. Two species. Syn.: *Kuehniella* Orr (see von Arx, 1971b, 1977b).

E(CC). Gametangia more or less equal, wound around one another; asci borne on short ascogenous hyphae; ascospores lenticular or oblate, often with an equatorial rim or furrow; ascocarps usually sessile..........................*Arachiotus*
Type species: A. *ruber* (van Tiegh.) Schroet., *in* Cohn's Kryptogamen-Fl. Schleisens 3(2): 211. 1893. Eight species (see von Arx, 1971b, 1977b; a different concept presented by Orr, Ghosh, and Roy, 1977). Syn.: *Disarticulatus* Orr; *Petalosporus* Ghosh, Orr & Kuehn; *Plunkettomyces* Orr; *Pseudoarachniotus* Orr & Kuehn; *Waldemaria* Batista, Silva Maia & Cavalcanti.

EE(CC). Gametangia ringlike; asci borne on croziers; ascospores lenticular with a thin equatorial ring, hyaline or pale yellowish; ascocarps elevated on hyphal tufts.......................*Narasimhella*
Type species: N. *hyalinospora* Kuehn, Orr & Ghosh) v. Arx, Persoonia 6: 374. 1971 (see Thirumalacher and Mathur, 1966). Two species known.

KEY TO THE GENERA OF ARTHRODERMOIDEAE

A. Peridial hyphae disarticulating at maturity...........B

AA. Peridial hyphae not disarticulating..................C

B(A). Ascospores flattened, oblate, with an equatorial band, smooth...........*Shanorella*
Type species: *S. spirotricha* Benjamin, El Aliso 3: 319. 1956. One species.

BB(A). Ascospores globose with finely echinulate walls.........................*Apinisia*
Type species: A. *graminicola* La Touche, Trans. Brit. Mycol. Soc. 51: 283. 1968. Two species (see Apinis and Rees, 1976).

C(BB). Tight coils not present, appendages

curved..................................*Spiromastix*
Type species: S. *warcupii* Kuehn & Orr, Mycologia 54: 160. 1962. One species.

CC(BB). Coils present, either as appendages or as peridia....................................D

D(CC). Constricted or dumbell-shaped hyphae not present in peridia, latter consisting of coiled hyphae..........................*Ajellomyces*
Type species: A. *dermatitidis* McDonough & Lewis, Mycologia 60: 77. 1968. Two species known (see Kwon-Chung, 1973). Syn.: *Emmonsiella* Kwon-Chung (see McGinnis and Katz, 1979).

DD(CC). Coils present as appendages; peridium consisting of more or less constricted cells.................E

E(DD). Peridial cells deeply constricted (dumbbell shaped) and relatively short; appendages coiled and uncommon; anamorph a *Trichophyton* Malst..................................*Arthroderma*
Type species: A. *curreyi* Berk., Outl. Brit. Fungol., p. 357. 1860. Thirteen species known (see Padhye and Carmichael).

EE(DD). Peridial cells slightly constricted and relatively long; appendages coiled, elongate and slender or macroconidial; anamorph a *Microsporon* Gruby.............*Nannizzia*
Type species: N. *gypsea* (Nannizzi) Stockdale, Sabouraudia 1: 46. 1961. Nine species known (see Apinis, 1964).

KEY TO THE GENERA OF GYMNOASCOIDEAE

A. Appendages conspicuous and regularly septate, each segment bearing unilateral enlargements or branchlets..............................*Ctenomyces*
Type species: C. *serratus* Eidam, *in* Cohn's Beitr. Biol. Pfl. 3: 274. 1880. One species (see Benjamin, 1956a; Orr and Kuehn, 1963b).

AA. If appendages are septate, segments not unilaterally enlarged.................................B

B(AA). Ascospores fusoid or ellipsoid................C

BB(AA). Ascospores globose to subglobose or oblate......................................D

C(B). Peridium and appendages dark brown to nearly black; appendages variously hooked, pointed, bramblelike and relatively conspicuous................................ *Mxyotrichum*
Type species: *M. chartarum* (Nees) Kunze, Myk. Hefte 2: 110. 1823. Ten species known (see Orr *et al.*, 1963c for key to species). Syn.: *Actinospira* Corda; *Eidamella* Matr. & Dass.; *Toxotrichum* Orr & Kuehn (see also von Arx, 1974b).

CC(B). Peridium not dark brown or black, light brown, yellow-brown, red, or yellow; appendages not readily observed, short, blunt........................*Pseudogymnoascus*
Type species: *P. roseus* Raillo, Zentbl. Bakt. Parasitkde, Abt. 2, 78: 520. 1929. Two species known (see Samson, 1972; Orr, 1979).

D(BB). Ascospores oblate................*Gymnoascus*
Type species: *G. reessii* Baranetsky, Bot. Zeit. 30: 158. 1872. Six species known (see Orr *et al.*, 1963a, 1977b; Samson, 1972; von Arx, 1974b, 1977b for a discussion of generic limits). Syn.: *Gymnascella* Peck; *Gymnoascoideus* Orr *et al.*; *Macronodus* Orr; *Neogymnomyces* Orr; *Tripedotrichum* Orr & Kuehn; and *Uncinocarpus* Sigler & Orr.

DD(BB). Ascospores globose to subglobose..........E

E(DD). Ascospores globose, wall smooth; peridium and appendages with tuberculate wall.*Pectinotrichum*
Type species: *P. llanense* Varsavsky & Orr, Mycopath. Mycol. Appl. 43: 331. 1971. One species known.

EE(DD). Ascospores globose to subglobose, wall rough or echinulate; peridium and appendages relatively smooth, not tuberculate.............................*Auxarthron*
Type species: *A. californiense* Orr & Kuehn, Can. J. Bot. 41: 1442. 1963. Seven or eight species known (see Samson, 1972; key to species in Orr, 1977a).

Dendrosphaeraceae Ciferri *ex* Benny & Kimbrough, *fam. nov.*

Dendrosphaeraceae [as Dendrosphaeriaceae], *nomem nudum*, Atti Ist. Bot. Univ. Pavia, Ser. 5, 14: 240. 1957 (without Latin diagnosis; Art. 36).

Ascocarpi longistipitati rhizomorphas basilares tenuis et aliquot receptacula (vel conceptacula) apicales formantes; receptacula globosa, elongata vel irregularia; asci numerosi, globosi, evanescentes, octospori, irregulariter dispositi, post maturitates pulveracei; ascosporae globosae, per hyphas vaginantes encrustatae et ornatae; capillitium hyaline septatum ex hyphis tenuibus enatum; anamorphosis ex aleurioconidiis constans.

Ascocarps long stipitate, forming slender basal rhizomorphs and several apical receptacles (or conceptacles); receptacles globose, elongate or irregular; asci numerous, globose, evanescent, eight spored, irregularly disposed, powdery after maturity; ascospores globose, encrusted and ornamented by ensheathing hyphae; capillitium hyaline, septate, arising from slender hyphae; anamorph consisting of aleurioconidia.

Holotype: *Dendrosphaera eberhardtii* Pat.

Discussion: The Dendrosphaeraceae contain a single genus, *Dendrosphaera eberhardtii* Pat., which was originally collected by Eberhardt in Tonkin (now northern Vietnam) and later was described by Patouillard (1907). Because of its large size it was compared with *Onygena* and *Trichocoma*. A second collection from the Molluccas (now Indonesia) was reported by Lloyd (1924), and both Saccardo (1913) and Clements and Shear (1931) placed *Dendrosphaera* in the Onygenaceae. In Boedijn's (1935b) studies of the development of *D. eberhardtii*, he revised Patouillard's description of the fungus and suggested that it belonged in a subfamily of the Onygenaceae, the Dendrosphaeroideae. In another publication, Boedijn (1935a) proposed three subfamilies of the Onygenaceae: Onygenoideae for *Onygena* only; Trichocomoideae for *Trichocoma* only; and Dendrosphaeroideae for *Dendrosphaera*. Large stipitate ascocarps characterized the family, while ascospore ornamentation, morphology, ontogeny, and habitat were considered adequate for subfamily distinction. Ciferri (1957) elevated Boedijn's family and subfamilies to ordinal and familial rank, although the Onygenaceae and Trichocomaceae had been used as families sometime earier (Cohn, 1872; Fischer, 1897). Ciferri failed to publish a Latin diagnosis for the Dendrosphaeraceae so we have provided one to validate the family.

Kobayasi (1975) redescribed *D. eberhardtii* and summarized its distribution, in southeast Asia (Malaya, Vietnam, Japan) and in Australasia (Java, Borneo, Malluca). Kobayasi (1976) was the first to describe and illustrate the aleurioconidial anamorph. It is largely on the basis of the anamorph that me are including the Dendrosphaeraceae in the Onygenales. The family contains the single monotypic genus with descriptions being provided by Patouillard (1907), Boedijn (1935b), and Kobayasi (1975). The fungus has been reported infrequently, although it might not be as rare as reports indicate since it has been collected several times in the same region of Asia (Boedijn, 1935b). Its large size, and rhizomorphs growing deeply within the soil, suggest that it might be mycorrhizal. More collections must be made, and one must note carefully the habitat, plant associations, and ontogenetic features before one can confidently establish its affinities to other taxa.

EUROTIALES Martin *ex* Benny & Kimbrough, *ord. nov.*

Eurotiales Martin, *nomen nudum*, Outline of the fungi, Studies Nat. Hist. Iowa Univ. 18(Suppl.): 16. 1941 (without Latin diagnosis; Art. 36).

Ascogonia helicoidea; ascocarpi nulli vel praesentes, nonostiolati, hyalini vel varie colorati, stromatici vel nonstromatici, ex hyphis vel pseudoparenchymatibus constantes; asci globosi, evanescentes, irregulariter dispositi, plerumque octospori; ascosporae unicellulares, hyalinae vel varie coloratae, laeves vel ornatae; anamorphosis plerumque ex phialoconidiis constans.

Ascogonia coiled; ascocarps lacking or present, hyaline or variously colored, nonostiolate, sromatic or nonstromatic, consisting of hyphae or pseudoparenchyma; asci globose, evanescent, irregularly disposed, usually eight spored; ascospores one celled, hyaline or variously colored, smooth or ornamented; anamorph usually consisting of phialoconidia.

We consider two families, the Trichocomaceae and the Cephalothecaceae.

Discussion: The Eurotiales contain fungi that have at various times been classified in several orders: Aspergillales (Bessey, 1950; Luttrell, 1951), Eurotiales (Martin, 1941a; Ainsworth, 1961, 1971; Alexopoulos, 1962; Fennell, 1973; Müller and Loeffler, 1976; Alexopoulos and Mims, 1979), Gymnascales (Clements and Shear, 1931), Hypocreales (Cain, 1956a, 1972; Malloch, 1979), Perisporales (Clements and Shear, 1931), Plectascales (Gäumann, 1928; Nannfeldt, 1932; Langeron and Vanbreuseghem, 1965; Dennis, 1968; 1978; Wehmeyer, 1975). Fennell (1973) included nine families in her treatemnt of the Eurotiales; Amorphothecaceae Parbery (1969), which she suggested may be closest to the Hemiphacidiaceae (Helotiales); Cephalothecaceae von Höhnel (1917); Eurotiaceae Clements & Shear (1931), a synonym of the Trichocomaceae; Gymnoascaceae (Benjamin, 1956a; Kuehn, 1958, 1959; von Arx, 1971b, 1977b), treated here under the Onygenales; Monascaceae Schroeter (1894), treated here under the Ascosphaerales; Onygenaceae (Malloch and Cain, 1971a), treated here under the Onygenales; Pseudeurotiaceae Malloch & Cain (1970b), a synonym of the Cephalothecaceae; Thermoascaceae Apinis (1967), whose two genera are now in separate families, *Thermoascus* in the Onygenaceae and *Dactylomyces* (Malloch and Cain, 1972b). Our treatment of the Eurotiales includes only two families: the Cephalothecaceae and the Trichocomaceae.

Although there is great variation in the type of ascocarp, all genera included here have a basic type of centrum structure, and with minor exceptions, a phialoconidial anamorph. Many genera have flanged or ridged ascospores without germ pores. Most have brightly colored conidia and mycelia.

Cain (1956a) believed the Aspergillaceae to be evolved from groups close to the Hypocreales or directly from them because of their similar phialidic anamorphs and brightly colored mycelium, conidia, and ascospores. Malloch and Cain (1972b) reemphasized these similarities in their treatment of these taxa under the Trichocomaceae, comparing stroma, ascocarp peridium, asci, ascospores, and anamorphs. Malloch (1979) placed the Trichocomaceae in the Hypocreales. Malloch (1970b) felt that the orgins of the Pseudeurotiaceae were obscure, but that members of the family have some features in common with members of the Diaporthales (*Endoxyla, Gnomonia, Phomatospora*). In the proposal of the new family, Malloch and Cain (1970b) noted that the

Pseudeurotiaceae differed from the Eurotiaceae (Trichocomaceae *sensu* Malloch and Cain) in having dark ascocarps and ascospores and simple conidiophores, but failed to mention an ordinal relationship. Malloch (1979), however, placed the Pseudeurotiaceae in the Diaporthales.

It would be unwise at this time to transfer these families to the Hypocreales and Diaporthales of the Pyrenomycetes. While existing data do suggest a possible evolutionary link between these taxa, they do not appear to us to justify a formal transfer. While it may be possible on occasion to link an isolated ascospore, peridial, or conidial characteristic, there will be numerous taxa in which no substantial link can be established. The Eurotiales is the appropriate order in which to maintain these taxa until further information is available.

KEY TO THE FAMILIES OF EUROTIALES

A. Ascocarps brightly colored; ascospores often pulley shaped; anamorphs of compound or rarely simple philoconidia.....Trichocomaceae (p.25)

AA. Ascocarps usually dark colored; ascospores not pulley shaped; anamorphs of simple phialoconidia or sympodulo-conidia..................................Cephalothecaceae (p.31)

Trichocomaceae Fischer, Nat. Pflanzenfam. 1(1): 310. 1897.
=Eurotiaceae

Hyphae hyaline to yellow or red, forming ascocarp initials on vegetative mycelium or within stromatic tissues. Ascogonia varying from tightly coiled pairs to large spiraled rings. Ascocarps remaining naked or buried within stromata, ellipsoidal, globose to hairy, soft to very firm, and nonostiolate, Peridium of compact hyphae, loose reticulum, or lacking. Asci globose to subcylindrical, irregularly disposed, stipitate or sessile, evanescent, with or without croziers. Ascospores oblate (bivalved) to ellipsoidal to globose, hyaline to yellow, red, or violet, smooth to roughened or ridged, often with an equatorial ridge or crest, without germ pores, and one celled. Anamorphs belonging to the phialoconidial states *Acremonium, Aspergillus, Gliocladium, Merimbla, Paecilomyces, Penicillium, Raperia, and Sagrahamala*, or lacking, conidia hyaline to brightly colored, rarely dark, smooth or sculptured.

Type genus: *Trichocoma* Junghuhn. Praemissa Fl. Crypt. Javae Ins. 1: 9. 1838. Twenty-two genera accepted.

Discussion: Most of the genera accepted here have traditionally been placed in the Aspergillaceae or Eurotiaceae. As was noted by Malloch and Cain (1972b) the name Trichocomaceae predates the Eurotiaceae and must be considered the valid family name. Benjamin (1955) pointed out the confusion that may occur when families are based solely on the anamorph, and despite the recent use of the name (Gäumann, 1964) Aspergillaceae, it can not be applied to the teleomorph.

Malloch (1970b) included a number of genera in the Trichocomaceae: *Dactylomyces*, *Dichlaena*, *Emericalla*, *Eupenicillium*, *Eurotium*, *Hemicarpenteles*, *Penicilliopsis*, *Sartorya* (now *Neosartorya*, Malloch and Cain, 1972b), *Talaromyces*, and *Trichocoma*. A large number of taxa were excluded from the family because they had been placed there based upon superficial characteristics. In an extensive treatment of the family, Malloch and Cain (1972b) recognized 16 genera, including five that were described as new. Several of these names were predated by those of Subramanian (1972), published approximately two months earlier. Malloch and Cain (1973b) recognized these synonyms and corrected the family name spelling from Trichocomataceae to Trichocomacear. Five genera have been added subsequently to the family, *Fennellia* (Wiley and Simmons, 1973) and *Hemisartorya* (Rai and Chowdhery, 1975) with *Aspergillua* anamorphs, *Sagonema* (Stolk and Orr, 1974) with an *Acremonium* anamorph, and we are adding *Aphanoascus* (anamorph a *Paecilomyces*) and *Roumegueriella* (anamorph a *Gliocladium*). Subramanian (1979) presented a discussion of ontogeny, anamorphic associations, illustrations, and a partial key to the members of the Trichocomaceae. We are including twenty-two genera in the Trichocomaceae which can be distinguished by using the following key.

KEY TO THE GENERA OF TRICHOCOMACEAE

A. Anamorph an *Aspergillus* or *Raperia*..................B
AA. Anamorph an *Acremonium*, *Gliocladium*, *Merimbla*, *Paecilomyces*, *Penicillium*, or *Sagrahamala*...........M
    B(A). Ascocarps lacking.......................*Edyuilla*
        Type species: *E. athecia* (Raper & Fennell) Subramanian, Curr. Sci. 41: 756. 1972. One species (see Raper and Fennell,

1965). Syn.: *Gymnoeurotium* Malloch & Cain.

BB(A). Ascocarps present...............................C

C(BB). Ascocarps developing within a sclerotium or sclerotic tissue...............................D

CC(BB). Ascocarps not developing within a sclerotium or sclerotic tissue.........................G

D(C). One to three or more cleistothecia borne in each stroma.......................E

DD(C). One ascocarp borne in each stroma..........F

E(D). Sclerotial tissue, except outermost layers, dissolving at maturity; young sclerotia covered with yellow, spicular hairs; ascospores smooth, no furrows.............*Dichlaena* Type species: *D. lentiscii* Mont. & Dur., Fl. Alg., p. 405. 1846-1849. Two species known (see Ram, 1971; Malloch and Cain, 1972b).

EE(D). Sclerotial tissues not dissolving at maturity; young sclerotia glabrous; ascospores with an equatorial grove.................*Petromyces* Type species: *P. alliaceus* Malloch & Cain, Can. J. Bot. 50: 2653. 1972. One species known (see Raper and Fennell, 1965). Syn.: *Syncleistostroma* Subram.

F(DD). Ascocarp wall thick and many layered; ascospores hyaline..*Hemicarpenteles* Type species: *H. paradoxus* Sarbhoy & Elphick, Trans. Brit. Mycol. Soc. 51: 156. 1968. Three species known (see Udagawa and Takada, 1971; Subramanian, 1972).

FF(DD). Ascocarp wall one layered; ascospores colored................*Sclerocleista* Type species: *S. ornata* (Raper, Fennell & Tresner) Subramanian, Curr. Sci. 41: 757. 1972. Two species.

G(CC). Ascocarp wall of loosely interwoven hyphae; ascospores ovoid and spinulose, globose to subglobose and winged.................H

GG(CC). Ascocarp with a definite wall, either composed of compressed hyphae or pseudoparenchymatous cells; ascospores lenticular.......I

H(G). Ascospores globose to subglobose with two wings and spines; anamorph an *Aspergillus*...........*Hemisartorya* Type species: *H. maritima* Rai &

Chowdhery, Kavaka 3: 73. 1979. One species (see Subramanian, 1979).

HH(G). Ascospores ovoid and spinulose; anamorph a *Raperia*..............*Warcupiella*
Type species: *W. spinulosa* (Warcup) Subramanian, Curr. Sci. 41: 757. 1972. One species (see Raper and Fennell, 1965; Subramanian, 1979). Syn.: *Sporophormis* Malloch & Cain.

I(GG). Ascocarps surrounded by hülle cells...............J

II(GG). Ascocarps not surrounded by hülle cells...........K

J(I). Ascogonia relatively large, globose cells......................*Fennellia*
Type species: *F. flavipes* Wiley & Simmons, Mycologia 65: 937. 1973. Two species (see Samson, 1979).

JJ(I). Ascogonia coiled.................*Emericella*
Type species: *E. variecolor* Berk. & Br. Intro. Cryptog. Bot. p. 340. 1857. Twelve species known (see Malloch, 1970b; Raper and Fennell, 1965; Cristensen and Raper, 1978 for keys to species; new species and combinations in Malloch and Cain, 1972a; Samson and Mouchacca, 1974, 1975a; Udagawa and Horie, 1976; Udagawa and Muroi, 1979; Horie, 1979).

K(II). Ascocarp wall composed of a single layer of flattened cells.......................*Eurotium*
Type species: *E. herbariorum* (Wigg.) Link *ex* Fr., Syst. Mycol. 3: 332. 1829. Seventeen or more species known (see Raper and Fennell, 1965; Malloch, 1970b; Blaser, 1976 for keys to species; new species and combinations in Malloch and Cain, 1972a; Samson and Mouchacca, 1974, 1975a).

KK(II). Ascocarp wall composed of several layers of flattened cells...............................L

L(KK). Ascocarp wall without appendages.....................*Neosartorya*
Type species: *N. fischeri* (Wehmer) Malloch & Cain, Can. J. Bot. 50: 2621. 1972. Twelve species (see

Raper and Fennell, 1965; Malloch and Cain, 1972b; Kwon-Chung and Kim, 1974). Syn.: *Sartorya* Vuill.

LL(KK). Ascocarp wall with projecting sterile hyphae..............*Chaetosartorya*
Type species: *C. chrysella* (Kwon-Chung & Fennell) Subramanian, Curr, Sci. 41: 761. 1972. Two species known (see Wiley and Simmons, 1973). Syn.: *Harpezomyces* Malloch & Cain.

M(AA). Asci formed in a stroma...........................N

MM(AA). Asci not formed in a stroma......................O

N(M). Stroma stipitate, containing fertile locules..............*Penicilliopsis*
Type species: *P. claviaeformis* Solms-Laubach, Ann. Jard. Bot. Buitenzorg 6: 53. 1887. One species known (see Malloch and Cain, 1972b).

NN(M). Stroma sessile; asci developing centripetally from the center of a pseudoparenchymatous stroma..*Eupenicillium*
Type species: *E. crustaceum* Ludwig, Lehrb. nied. Krypt., p. 263. 1892. More than 30 species known (see Malloch, 1970b; Pitt, 1974 for key to species; new species by Stolk and Veenbaas-Rijks, 1974; Udagawa and Horie, 1977).

O(MM). Ascocarps lacking; anamorph a *Paecilomyces*.........................*Byssochlamys*
Type species: *B. nivea* Westling, Sven. Bot. Tidskr. 3: 134. 1909. Four species known (see Stolk and Samson, 1971; Samson and Tansey, 1975).

OO(MM). Ascocarps present................................P

P(OO). Ascocarps several mm tall, brush-like.....................*Trichocoma*
Type species: *T. paradoxa* Junghuhn, Praemissa Fl. Crypt. Javae Ins. 1: 9. 1838. One species known (see Boedijn, 1935a; Kominami *et al.*, 1952; Malloch and Cain, 1972b).

PP(OO). Ascocarps smaller, not brushlike..........Q

Q(PP). Ascocarp wall cellular...........................R

QQ(PP). Ascocarp wall composed of several layers of loosely interwoven hyphae; usually not thermophilic..........................T

R(Q). Ascocarp brown, composed of one or more layers of pseudoparenchymatous cells; thermophilic.........................*Dactylomyces*
Type species: *D. thermophilus* Sopp, Skr. Vidensk. Skrift Cristian. Mat.-naturv. 11: 35. 1912. Two species (see Stolk, 1965; Apinis, 1967).

RR(Q). Ascocarps cream colored to orange..................................S

S(RR). Ascocarp red-orange, composed of a sclerotioid inner tissue of thick-walled cells surrounded by loose wefts of encrusted hyphae; not thermophilic; anamorph a species of *Paecilomyces*.......................*Aphanoascus*
Type species: A. *cinnabarinus* Zukal, Ber. Deut. Bot. Ges. 8: 296. 1890. One species known (see Udagawa, Furuya, and Horie, 1973; Udagawa and Takada, 1973; Jong and Davis, 1975).

SS(RR). Ascocarps cream to light orange, composed of a two layered peridium, the outer of thin-walled cells, a *textura globosa* in surface view......*Roumegueriella*
Type species: R. *rufula* (Berk. & Br.) Malloch & Cain, Can. J. Bot 50: 64. 1972. One species (see Hughes, 1951).
Syn.: *Lilliputia* Boud. & Pat.

T (QQ). Peridial hyphae thick walled, sometimes appendaged.............*Sagenoma*
Type species: *S. viride* Stolk & Orr, Mycologia 66: 676. 1974. One species known.

TT(QQ). Peridial hyphae relatively thin walled, not appendaged..................U

U(TT). Asci produced singly from croziers.........*Hamigera*
Type species: *H. avellanea* Stolk & Samson, Persoonia 6: 344. 1971. Two species known.

UU(TT). Asci produced in chains, not from croziers..............................*Talaromyces*
Type species: *T. vermiculatus* (Dang.)

C.R. Benjamin, Mycologia 47: 684. 1955. Sixteen or more species known. New species described by Stolk and Samson, 1972; Samson and Mahoney, 1977. Syn.: *Carpenteles* Langeron.

Cephalothecaceae von Höhnel, Ann. Mycol. 15: 362. 1917.
=Pseudeurotiaceae Malloch & Cain, Can. J. Bot. 48: 1815. 1970.

Ascocarp initials coiled, mature ascocarps globose to subglobose, glabrous, covered with a tomentum, or appendaged, haline or black. Peridium pseudoparenchymatous or cephalothecoid. Asci globose to clavate, evanescent, irregularly disposed in the centrum. Ascospores one celled, without germ pores, sheathed or unsheathed, smooth or variously ornamented, variously shaped. Anamorphs phialoconidial, sympoduloconidial, chlamydosporic, or lacking.

Type genus: *Cephalotheca* Fuckel, Symb. Mycol. Nachtr. 1: 297. 1871. Ten genera are accepted, inclusive of those formerly placed in the Pseudeurotiaceae (Malloch and Cain, 1970b).

Discussion: The family Cephalothecaceae was created for *Cephalotheca* and other cleistothecial Ascomycetes with a cephalothecoid (platelike) peridium (von Höhnel, 1917). These genera include: *Argynna*, *Cephalotheca*, *Eosphaeria*, *Marchaliella*, *Samarospora*, *Testudina*, and *Zopfiella*. Nannfeldt (1932) followed von Höhnel in reserving the family for those fungi with a cephalothecoid peridium. Ciferri (1958) added a new stipitate genus, *Batistia*, based upon *Xylaria annulipes* Mont. and proposed two tribes, the Batistieae for the stipitate and woody *Batistia* and the Cephalothecieae for the remaining carbonaceous and sessile taxa. Malloch and Cain (1970b) revised the concept of the Cephalothecaceae to include only the genus *Cephalotheca*. They disregarded the cephalothecoid peridium as a valid family character since this wall type had been found in a number of unrelated taxa. Malloch and Cain were unable to germinate the ascospores of *Cephalotheca sulfurea* Fuckel and, therefore, they were unable to determine whether or not germ pores were present. They (Malloch and Cain, 1970b) were able to observe that germ pores were lacking in the ascospores of several other plectomycetous taxa related to *C. sulfurea*. For those remaining genera, *Emericellopsis*, *Fragosphaeria*, *Pseudeurotium*, and *Testudina*, and five new genera, *Cryptendoxyla*, *Hapsidospora*, *Leuconeurospora*, *Mycoarachis*, and *Nigrosabulum*. Germ pores, if they are present in the ascospore wall, should be visible when observed with the light micorscope. The inability to convincingly demonstrate germ pores in ascospores of *Cephalotheca sulfurea* is a weak basis for maintaining *Cephalotheca* in a separate family since all of the other characteristics of the Cephalothecaceae and Pseudeurotiaceae are similar. If germ pores are later found to be present in the ascospores of *C. sulfurea* and other characters also support this difference, then both families can again be maintained. We agree, however with Malloch and Cain (1970b) that the presence of a cephalothecoid peridium alone is not justification for placing taxa in the Cephalothecaceae. Platelike peridia have been found also in the following taxa: Microascaceae (Plectomycetes); Chaetomiaceae, Sordariaceae (Pyrenomycetes); Eremomycetaceae, Testudinaceae (Loucloascomycetes) (Malloch, 1970b; Hawksworth and Booth, 1974). Recently, additional taxa have been described with this type of wall: *Chaetomidium arxii* Benny (1980; Chaetomiaceae), *Rhytidospora* spp. (Jeng and Cain, 1977; Krug and Jeng, 1979; Melanosporaceae), and several new genera of the Testudinaceae (Hawksworth, 1979). Cleistothecial genera of uncertain affinities also produce cephalothecoid peridia: *Albertinella* (Kirschstein, 1936), *Argynna* (Morgan, 1895; see also Martin, 1941b), and *Batistia* (Ciferri, 1958). Von Arx (1971a) placed *Argynna*, *Neotestudina*, and *Testudina*, along with *Lepidosphaeria* and *Pseudophaeotrichum* in the Testudinaceae of the Pseudosphaeriales. The Testudinaceae and Phaeotrichaceae are considered by von Arx and Müller (1975) to be synonymous with the Zopfiaceae (Pseudosphaerineae, Dothideales). Barr (1976, 1979a, 1979b) later included the Zopfiaceae (as a synonym of the Massariaceae) in the Melannommatales (Loculoedaphomycetidae, Loculoascomycetes).

With these transfers the following genera remained in the Cephalothecaceae: *Cephalotheca*, *Cryptendoxyla*, *Emericellopsis*, *Fragosphaeria*, *Hapsidospora*, *Leuconeurospora*, *Mycoarachis*, *Nigrosabulum*, and *Pseudeurotium*. *Mycoarachis inversa* Malloch and Cain should not be in this group as Malloch and Cain (1970b) suggest since it produces two-celled ascospores. It probably has affinities with the Hypocreales. Greenish ascospores and a *Cephalosporium*-like anamorph are common in the latter order. *Leuconeurospora* was transferred to the Micorascaceae by von Arx (1978; see the discussion under Microascales and Pithoascaceae). Three genera of Pseudeurotiaceae (Cephalothecaceae as interpreted here) have been proposed in recent years: *Aporothielavia* (Malloch and Cain, 1973a), *Connersia* (Malloch, 1974a), and *Leucosphaera* (von Arx *et al.*, 1978). Hawksworth (1979) did not include *Argynna* among the genera that he placed in the Zopfiaceae.

The following key is based, in part, on one presented by Malloch and Cain (1970b).

KEY TO THE GENERA OF CEPHALOTHECACEAE

A. Ascocarp wall cephalothecoid............................B

AA. Ascocarp wall not cephalothecoid......................E

B(A). Ascospores cylindrical, smooth walled..............................*Cryptendoxyla*
Type species: *C. hypophoia* Malloch & Cain, Can. J. Bot. 48: 1816. 1970.
One species known.

BB(A). Ascospores ellipsoidal, fusoid, or reniform.....................................C

C(BB). Ascospores reniform...................*Fragosphaeria*
Type species: *F. purpurea* Shear, Mycologia 15: 124. 1923. Two species known see Chesters, 1934).

CC(BB). Ascospores ellipsoid..............................D

D(CC). Ascocarps covered with a yellow tomentum...............*Cephalotheca*
Type species: *C. sulfurea* Fuckel, Symb. Mycol. Nachtr. 1: 297. 1871.
One or two species (see Malloch and Cain, 1970b; Ram, 1971).

DD(CC). Ascocarps white, tomentose, often with several dark appendages..................*Aporothielavia*
Type species: *A. leptoderma* (Booth) Malloch & Cain, Mycologia 65: 1074. 1973. One species known.

E(AA). Ascospores with a sheath..............*Leucosphaera*
Type species: *L. indica* von Arx, Mukerji & Singh, Persoonia 10: 141. 1978.
One species known.

EE(AA). Ascospores lacking sheath.........................F

F(EE). Ascospore wall ornamented................G

FF(EE). Ascospore wall smooth...................H

G(F). Ascospores ellipsoid, with hyaline wings.......................*Emericellopsis*

Type species: *E. terricola* van Beyma, Ant. van Leeuwen. Ned. Tijdschr. Hyg. 6: 265. 1940. Two to nine species recognized (see Groslags and Swift, 1957; Malloch and Cain, 1970b; Beljakova, 1974b).

GG(F). Ascospores globose with reticulations...*Hapsidospora*
Type species: *H. irregularis* Malloch & Cain, Can. J. Bot. 48: 1819. 1970. Two species known (see Beljakova, 1975).

H(FF). Ascospores light brown.........*Pseudeurotium*
Type species: *P. zonatum* van Beyma, Zent. Bakt., Abt. II, 96: 416. 1937. Two or three species (see Malloch and Cain, 1970b).

HH(FF). Ascospores hyaline.........................I

I(HH). Ascospores globose....................*Nigrosabulum*
Type species: *N. globosum* Malloch & Cain, Can. J. Bot. 48: 1823. 1970. One species.

II(HH). Ascospores lunate, ovoid, or elliptical, depending on the surface viewed..........*Connersia*
Type species: *C. rilstonii* (Booth) Malloch, Fungi Canadensis No. 32: 1. 1974. One species.

ASCOSPHAERALES Gaümann *ex* Benny & Kimbrough, *ord. nov.*

Ascosphaerales Gaümann, *nomen nudum*, Die Pilze, Birkhaüser, Basel und Stuttgart, p. 107. 1964 (without Latin diagnosis; Art. 36).

Ascocarpi reducti, simplices, nonostiolati, sine appendicibus, cum muro celluloso vel noncelluloso; asci deliquescentes, singuli vel aliquot per ascocarpum; ascosporae unicellulares, hyalinae vel pigmentosae, sine poris germinantibus, liberae vel in sphaerulis compactis glomeratae; anamorphoses ex aleurioconidiis vel arthroconidiis meristemibus constantes.

Ascocarps reduced, simple, nonostiolate, lacking appendages, with cellular or noncellular wall; asci deliquescent, single or several per ascocarp; ascospores one celled, hyaline or pigmented, without germination pores, free or united into compact spore balls; anamorphs consisting of aleurioconidia or meristem arthrospores.

Two families are considered here, the Ascosphaeraceae and Monascaceae.

Discussion: Ascosphaera and *Monascus*, the two genera on which these families are based, are both anomalies within the Ascomycetes. *Ascosphaera* was long considered related to the Endomycetaceae (Gaümann, 1928), while *Monascus* has been traditionally accepted as a reduced member of the Eurotiales. Spiltoir and Olive (1955) interpreted the enlarged ascogonium within which asci develop as a reduced cleistothecium and related it to the development found in *Monascus*. Both have a morphologically comparable ascogenous system, a reduced vegetative phase, a peridium composed of a single wall or a thin cellular sheath, ascogenous hyphae developing within an enlarging ascogonial cell, early deliquescence of asci from their point of attachment, asci floating free within a liquid centrum, eventual deliquescence of asci leaving spores or membrane-bound groups of spores, *i.e.*, spore balls, within the cavity, and anamorphs which are arthroconidial or meristem arthroconidial. Morphologically and developmentally they are similar and possibly related, and on this basis we include them in the same order.

One can only speculate on the relationship of the Ascosphaerales to other groups of Ascomycetes. In reference to plectomycetous taxa, Cain (1972) stated that "with the exception of the Onygenaceae and Monascaceae whose affinity is with the Pezizales, the families are related to various orders of ostiolate Ascomycota." Malloch (1979) placed the Monascaceae in the Pezizales but stated that *Monascus* may well represent the sole genus in a highly evolved family, and not just a simple, reduced discomycete. We see no justification for considering the Monascaceae closely related to the Pezizales, although they could possibly have had a common ancestry. While ascogonial and early ascocarp development are somewhat similar to those of certain Pezizales, peridial, ascal, and other features are too variable to make an accurate comparison. Most anamorphs of the Pezizales are blastoconidial, rarely sympoduloconidial; not arthroconidial or aleurioconidial.

Considerable interest was shown in the presence of a trichogyne in *Ascosphaera* (Spiltoir, 1955) in which its occurrence suggested a possible relationship to the higher Ascomycetes. While a trichogynal element is present in *Ascosphaera*, its ontogeny is quite different from those formed by numerous Pezizales. Multiple trichogynes present in *Bettsia* and *Arrhenosphaera* are somewhat suggestive of those in *Coprotus* and *Pyronema* (Pezizales), but too little is known about the cytological features of the ascogenous system in the Ascosphaeraceae to make a comparison beyond that point.

Although the presence of trichogynes and other ascogonial features of the Ascosphaeraceae and Monascaceae point to a possible phylogenetic relationship to higher ascomycetes, we disagree with the transfer of either of these taxa to the Pezizales. Fennell (1973) has noted a similar manner of ascus detachment and free-floating asci in the Ascosphaeraceae and Ophiostomataceae. This feature alone, however, is insufficient to suggest a relationship there. Luttrell (1955) suggested that the Pericystales (=Ascosphaerales *s.s.*) may represent a disjunct taxon perhaps related to the Gymnoascales (=Onygenales here). We propose to retain them in the Plectomycetes.

KEY TO THE FAMILIES OF ASCOSPHAERIALES

A. Ascocarp walls acellular; associated with bees..............................Ascosphaeraceae
AA. Ascocarp walls cellular; osmophilic, found in starcy substrates, or legume roots.Monascaceae

Ascosphaeraceae Olive & Spiltoir *in* Spiltoir and Olive, Mycologia 47: 242. 1955.

=Synascomycetaceae Vartichak, Le Botaniste 25: 365. 1933 (not validly published, Art. 36; see Cooke and Hawksworth, 1970).

=Pericystaceae Bessey, Morph. Tax. Fungi, p. 352. 1950 (not validly published, Art. 36; see Cooke and Hawksworth, 1970).

Hyphae septate; ascogonia swollen, with one to several trichogynes, becoming the nutricyte or acellular wall of the ascocarp; asci eight spored, produced in membrane-bound balls, upon evanescence ascospores may or may not remain in membrane-bound spore balls; ascospores one celled; anamorph a *Chrysosporium*, or absent; associated with honeybees, leaf cutting bees, and solitary bees.

Type genus: *Ascosphaera* Olive & Spiltoir. Three genera known.

Discussion: *Ascosphaera*, known in the older literature as *Pericystis*, may represent the most simplified plectomycete. The species of this genus have received considerable attention as the cause of chalk brood and other diseases in beehives. Spiltoir (1955) has shown that from a swollen cell of the female gametangium a trichogyne is extended and contacts a male hypha, plasmogamy occurs, and a portion of the trichogyne adjacent to the swollen cell produces an intrahyphal growth that extends back into the swollen cell. The intrahyphal growth with compatable nuclei becomes branched and through a crozier system forms asci at various levels within the large thick-walled cell. Spiltoir and Olive (1955) referred to this cell as a "nutriocyte." Within the nutriocyte numerous asci develop and eventually deliquesce, leaving spore balls throughout. Variable numbers of asci may be surrounded by a common membrane, which after ascal deliquescence becomes a large spore ball. If the nutriocyte is interpreted as a highly reduced ascocarp with deliquescent asci irregularly disposed, the fungus can be construed to be a plectomycete.

The family Ascosphaeraceae was created for two species and one variety of the genus *Ascosphaera* (Spiltoir and Olive, 1955). The genus had previously been placed in the Synascomycetaceae by Vartichak (1933) and the Pericystaceae by Bessey (1950). Gäumann (1964) placed the family in an order of its own, removing it from the Eurotiales where it was originally placed by Spiltoir and Olive. Skou (1972) erected the new genus *Bettsia* based on *Ascosphaera alvei* (Betts) Olive & Spiltoir, a saprophyte on stored pollen in the beehive. *Ascosphaera apis* (Maassen & Claussen) Olive & Spiltoir var. *major* (Pröksch1 & Zobl) Olive & Spiltoir was raised to species rank and a new species *Ascosphaera proliperda* Skou, was described. Stejskal (1974) described the new genus *Arrhenosphaera* and compared it with other taxa in the family. Skou (1975) described two new species of *Ascosphaera*, *A. aggregata* Skou and *A. fimicola* Skou, and the anamorph of *Bettsia alvei* (Betts) Skou, *Chrysosporium farinaecola* (Burnside) Skou. Fennell's (1973) suggestion that the Ascosphaeraceae and Ophiostomataceae may be related was not accepted by Skou (1975) who follows Luttrell (1955) in considering them a disjunct taxon possibly related to the Eurotiales.

KEY TO THE GENERA OF ASCOSPHAERACEAE

A. Ascogonia with 3-10 trichogynes; asco-

spores globose to ovoid; spore balls
breaking apart early................................B

AA. Ascogonia with one trichogyne; ascospores ellipsoid, short, cylindrical, or allantoid; spore balls remain intact.....*Ascosphaera*
Type species: A. *apis* (Maassen & Claussen) Olive & Spiltoir, *in* Spiltoir and Olive, Mycologia 47: 242. 1955. Six species known see Skou, 1972, 1975, 1979). Syn.: *Pericystis* Betts *non Pericystis* Agardh (see Spiltoir and Olive, 1955).

B(A). Spore cysts small, 19-34 µm in diam, variable in shape, containing a single spore ball; ascospores sphaerical; 3 trichogynes present.........*Bettsia*
Type species: B. *alvei* (Betts) Skou, Friesia 10: 7. 1972. One species.

BB(A). Spore cysts larger, 220-500 µm in diam, with several spore balls; ascospores sphaerical to ovoid; 4-10 trichogynes present..........*Arrhenosphaera*
Type species: A. *cranei* Stejskal, J. Apicult. Res. 13: 44. 1974. One species known.

Monascaceae Schroter, *in* Engler and Prantl, Nat. Pflanzenfam. 1(1): 148. 1894.

Mycelium hyaline to pinkish, slender; ascocarp initials produced as a forked branch with one branch becoming swollen and curved and the other remaining slender and eventually surrounding the first; ascocarps small, reddish, nonostiolate, produced on a stalklike hypha, glabrous, transparent; ascocarp peridium very thin and poorly differentiated, one to two cells deep in cross section, cells gelatinizing, forming a crust; asci irregularly disposed, subglobose to globose, evanescent, without croziers; ascospores hyaline to reddish, enclosed after ascal dissolution in a saclike membrane derived from the inner peridial cells; anamorphs arthroconidial or meristem arthrospores.

Type genus: *Monascus* van Tiegh. Four genera accepted.

Discussion: Ascocarps of *Monascus* have poorly differentiated peridia which are one to two cells thick. They are initiated as a forked branch with one branch becoming swollen and the other remaining filamentous and eventually coiling around it. Ascogenous hyphae developing from within the centrum often form both binucleate and uninucleate cells which soon become detached in most taxa, floating free within a liqud matrix. An enlarging ascogonial cell within the centrum appears to be the dominant characteristic of the Monascaceae. The peridial wall gelatinizes in *Monascus* but remains parenchymatous in other genera. Malloch (1970b) placed two genera in the family, *Ascorhiza* and *Monascus*, and Samson and Mouchacca (1975b) added *Leiothecium* which they had isolated from soil. While we include *Leiothecium* in our key to the genera of the Monascaceae, we have great reservations about its inclusion here. The ascogonial coil of *Leiothecium* does not have the enlarged cell typical of the other genera included here. Samson and Mouchacca did not illustrate or describe the development of the ascogenous and centrum tissues. Without this information we can not established family relationships. *Ascorhiza* has been found in the root nodules of legumes (Lechtova-Trnka, 1931) and *Xeromyces* and *Monascus* are small organisms usually associated with fermenting, starchy substrates or, as in *Xeromyces*, osmophilic (Fraser, 1953). Malloch (1970b) placed *Xeromyces* in the Thelebolaceae of the Pezizales, and later in the Pyronemataceae (Malloch, 1979), but clearly it does not belong here. The ascogenous system is distinctly different in *Thelebolus* and *Pyronema*, and Samuelson and Kimbrough (1978) have shown that ultrastructurally the asci of *Thelebolus* are a modified bitunicate type suggesting relationships to the Loculoascomycetes. The genus *Backusia* described by Thirumalacher *et al.* (1964) has been shown by Cole and Kendrick (1968) to be synonymous with *Monascus*.

Genera of the Monascaceae are usually placed in or near the Eurotiales. In morphology and development they appear to be more closely related to the Ascosphaeraceae.

KEY TO THE GENERA OF MONASCACEAE

A. Ascospores smooth; on starchy, fermenting or osmophilic substrates..............................B
AA. Ascospores reticulate; in roots or soil...............C
  B(A). Asci two spored; peridium not gelatinizing; osmophilic...............*Xeromyces*
    Type species: X. *bisporus* Fraser, Proc. Linn. Soc. NSW 78: 245. 1953.
    One species (see Malloch, 1970b).
  BB(A). Asci eight spored; peridium gelat-

inizing; on starchy, fermenting substrates............................*Monascus*
Type species: *M. ruber* van Tieghem, Bull. Soc. Bot. France 31: 226. 1884. Many species (see Malloch, 1970b).
Syn.: *Backusia* Thirumalacher, Whitehead & Mathur.

C(BB). In root nodules; ascogonia and antheridia paired asci forming from disassociated ascogonial cells within an enlarging primordial cell......................*Ascorhiza*
Type species: *A. leguminosarum* Lechtova-Trnka, Compt. Rend. Hebd. Seances Acad. Sci. 192. 497. 1931. One species known.

CC(BB). Found in soil; ascogonia and antheridia not paired; asci not developing inside swollen primordial cells................*Leiothecium*
Type species: *L. ellipsoideum* Samson & Mouchacca, Can. J. Bot. 53: 1634. 1975. One species known.

MICROASCALES Luttrell *ex* Benny & Kimbrough, *ord. nov.*

Microascales Luttrell, *nomen nudum*, Taxonomy of the Pyrenomycetes, Univ. Missouri Studies 24(3): 108. 1951 (without Latin diagnosis; Art. 36).

Ascocarpi globosi, pyriformes vel irregulares, plerumque atrocolorati, ostiolati vel nonostiolati, cum vel sine appendicibus; asci solitari vel catenulati, ovoidei vel globosi, octospori, deliquescentes; ascosporae dextrinoideae, unicellulae, atrocoloratae, cum 1-2 vel sine poris germinantibus; anamorphoses ex annelloconidiis, aleurioconidiis, vel arthroconidiis constantes.

Ascocarps globose, pyriform or irregular, usually dark colored, ostiolate or nonostiolate, with or without appendages; asci solitary or catenulate, ovoid or globose, eight spored, deliquescent; ascospores dextrinoid, one celled, dark colored, with one or two or without germination pores; anamorphs consisting of annelloconidia, aleurioconidia, or arthroconidia.

Three families recognized: Chadefaudiellaceae, Microascaceae, and Pithoascaceae.

Discussion: The family Microascaceae was proposed by Luttrell (1951) to accomodate *Microascus* which had been placed traditionally in the Ophiostomataceae (Nannfeldt, 1932) or the Eurotiaceae (Emmons and Dodge, 1931). Members of the family were characterized as having beaked ascocarps with evanescent asci disposed irregularly thoughout the centrum. Luttrell separated *Microascus* from other taxa of the order on the basis of centrum structure. The centrum of members of the Microascaceae consists of filamentous cells and that of Ophiostomataceae of pseudoparenchyma. Corlett (1966) added *Petriella* to the family. Barron *et al.* (1961a, 1961b) noted that these taxa were characterized by predominantly asymmetrical, honey-colored to reddish-brown, hairy ascocarps. Corlett (1963, 1966) observed that asci developed directly from filamentous ascogenous hyphae, not croziers. Various annelloconidial and aleurioconidial states have been reported as anamorphs, including *Scopulariopsis*, *Graphium*, *Doratomyces*, *Sporothrix*, and *Wardomyces*. A notable addition to the emended family was the inclusion by Malloch (1970a) of taxa with nonostiolate ascocarps. He concluded that Microascaceae most closely resemble Chaetomiaceae but differ from the latter in having dextrinod ascospores and in lacking croziers, and that the asci are irregularly disposed as opposed to fascicled. He included four ostiolate genera, *Lophotrichus*, *Microascus*, *Petriella*, and *Pithoascus*, and two cleistocarpus genera, *Petriellidium* and *Kernia*.

In a monograph of *Lophotrichus*, Seth (1971) emended the genus and described a new species. He proposed the family Lophotrichaceae for this genus and placed it in the Microascales, noting that its production of irregular asci excluded it from the Chaetomiales. A comparison of centrum development in *Lophotrichus* (Whiteside, 1962) and in *Microascus* (Corlett, 1963, 1966) clearly indicates that these taxa cannot be placed in separate families. Therefore, we are retaining *Lophotrichus* in the Microascaceae (*sensu* Malloch, 1970a) since this name has priority over the Lophotrichaceae (Seth, 1971). Von Arx (1973b) described a new genus *Pithoascus* based upon three species previously included in *Microascus* [*P. intermedius* (Emmons & Dodge) v. Arx, *P. nidicola* (Massee & Salmon) v. Arx, and *P. Schumacheri* (Hansen) v. Arx]. He later transferred *Microascus exsertus* Skou to and described two new species of *Pithoascus*, and added four new species to *Petriellidium* (von Arx, 1973c). Von Arx provided a key to species of both *Pithoascus* and *Petriellidium*.

In his revision of *Microascus*, von Arx (1975c) described one new species and noted the close similarity of certain species to members of *Kernia* and *Chaetomium*. *Leuconeurospora* was proposed by Malloch and Cain (1970b) to accommodate *Eurotium pulcherrimum* Wint. and was tentatively placed in the Pseudeurotiaceae. Udagawa and Furuya (1973) later examined *Leuconeurospora* and, because of its irregularly disposed asci and one-celled, reddish-brown ascospores, suggested a possible relationship to *Microascus*, although they could not determine if the ascospores were dextrinoid or if germ pores were present. Von Arx (1978) includes *Leuconeurospora* in his key to the Microascaceae, although he seriously questions its status there and suggested that it may be related to the Sordariaceae or to the Testudinaceae (which has dothidiaceous affinities). We agree that it does not belong in the Microascaceae. A similar species was described by Locquin-Linard (1975) as the type species of the new genus *Faurelina*. This genus, like *Pithoascus*, has dextrinoid ascospores but lacks germ pores (von Arx, 1978). In addition, they both produce arthroconidia, not annelloconidia which are typical of the family. On this basis we are setting aside *Faurelina* and *Pithoascus* and placing them in a new family, Pithoascaceae.

Locquin-Linard (1977) recognized an additional genus, *Enterocarpus*, a nonostiolate member of the Microascaceae with apical tufts of hairs and ascospores surrounded by a hyphal "capillitium." Centrum features need to be compared with those of *Kernia* and *Microascus*. Until *Enterocarpus* is compared with other members of the Microascaceae it will be difficult to determine whether the "capillitium" is merely elongated paraphysoidal elements as are found in *Microascus* or if they are unique structures that can be used for generic distinction.

Dispite the unique type of ascocarp, were are including *Chadefaudiella* (Chadefaudiellaceae) in the Microascales because of the similarity of centrum ontogeny, especially the formation of chained asci and paraphysoidal elements, to members of the Microascaceae (Corlett, 1963; Locquin-Linard, 1973; Parguey-Leduc, 1977).

KEY TO THE FAMILIES OF MICROASCALES

A. Ascospores with one or two germ pores; anamorphs annelloconidial or aleurioconidial..................................Microascaeae (p. 43)

AA. Ascospores without germ pores; anamorph arthroconidial or lacking............................B

B(AA). Ascocarps all pseudoparenchymatous; ascospores dextrinoid when young; anamorphs arthroconidial..........Pithoasaceae (p. 45)

BB(AA). Ascocarps with pseudoparenchymatous tissue below, parallel, branching, anastomosing, thick-walled hyphae above (=so-called capillitium); ascospores ?dextrinoid; anamorphs unknown......................Chadefaudiellaceae (p. 46)

Microascaceae Luttrell *ex* Malloch, Mycologia 62: 734. 1970.

Microascaceae Luttrell, *nomen nudum*, Taxonomy of the Pyrenomycetes, Univ. Missouri Studies 24(3): 108. 1951 (without Latin diagnosis, Art. 36).

=Lophotrichaceae Seth, Nova Hedwigia 19: 592. 1971 (1970).

Ascocarps variously shaped, appendaged, tomentose, or glabrous, dark; ascocarp initials coiled; asci evanescent, formed singly or catenulate, variously shaped, lacking croziers; ascospores one celled, dextrinoid when young, straw to copper colored at maturity, wall smooth, with one or two germ pores; anamorphs aleurioconidial, annelloconidial, or absent.

Type genus: *Microascus* Zukal. Six genera known.

Discussion: When Luttrell (1951) proposed the Microascales, he included two families, the Microascaceae and Ophiostomataceae. Barron *et al.* (1961a, 1961b), Corlett (1963, 1966), Malloch (1970a), and von Arx (1973c, 1975c, 1978) have more or less recognized this relationship. Malloch (1970a) redefined the family to include both ostiolate and nonostiolate taxa while von Arx further extended the family to include taxa that produce arthroconidial anamorph and ascospores without germ pores. We exclude the latter taxa, however, and include only the six genera that form ascospores with germ pores in the Microascaceae. The key below is adapted from that of von Arx (1978).

KEY TO THE GENERA OF MICROASCACEAE

A. Ascocarps with a wall of *textura epidermoidea;* ascospores with two germ pores;

anamorphs include *Graphium*, *Scedosporium*, and *Arthrographis*....................................B

AA. Ascocarps with pseudoparenchymatous walls composed of angular, dark cells.......................C

B(A). Ascocarps ostiolate; ascospores reddish brown, often asymmetrical......*Petriella*
Type species: *P. sordida* (Zukal) Barron & Gilman, *in* Barron, Cain, and Gilman, Can. J. Bot. 39: 839. 1961. Six species known (see Barron *et al.*, 1961a; Malloch, 1970a).

BB(A). Ascocarps usually not ostiolate; ascospores usually yellowish, rarely reddish, symmetrical..............*Petriellidium*
Type species: *P. boydii* (Shear) Malloch, Mycologia 62: 738. 1970. Six species known (see von Arx, 1973c).

C(AA). Ascospores embedded in a hyphal "capillitium" at maturity, each with a prominant germ pore.............................*Enterocarpus*
Type species: *E. uniporus* Locquin-Linard, Rev. Mycol. 41: 513. 1977. Two species.

CC(AA). Ascospores small, not embedded in a "capillitium," or with two germ pores............D

D(CC). Ascocarps ostiolate; ascospores asymmetrical, with one germ pore...........................*Microascus*
Type species: *M. longirostris* Zukal, Verh. Zool.-Bot. Ges., Wien 35: 339. 1885. Twelve species known (see von Arx, 1975c for key to species; additional species described by Ram, 1971; Udagawa and Furuya, 1978; see also Barron *et al.*, 1961b; Morton and Smith, 1963).

DD(CC). Not as above.............................E

E(CC). Ascocarps nonostiolate, with or without tufts of hairs; ascospores with one or two germ pores, hyaline, reddish, yellowish, or brownish..........................*Kernia*
Type species: *K. nitidia* (Sacc.) Nieuwland, Amer. Midl. Nat. 4: 379. 1916. Five species known (see Malloch and Cain, 1971c for key to species). Syn.: *Magnusia* Sacc. *non Magnusia* Klotzsch (see Benjamin, 1956b).

EE(CC). Ascocarps usually ostiolate, with an apical tuft of thick-walled hairs; ascospores with two germ pores, yellowish or brownish..................*Lophotricus*
Type genus: *L. ampullus* Benjamin, Mycologia 41: 347. 1949. Five species known (see Seth, 1971 for key to species; additonal species described by Morinaga *et al.*, 1978).

Pithoascaceae Benny & Kimbough, *fam. nov.*

Ascocarpi globosi vel ellipsoidei, nigri vel atrocolorati, immersi vel semiimmersi, raro superficiales, ostiolati vel nonostiolati, solitarii vel aggregati, saepe crustacei; asci globosi vel subclavati, evanescentes, octospori; ascosporae in statu juvenili dextrinoideae, laeves vel cum costis longitudinalibus, fusiformes vel naviculiformes, pallidae vel atrocoloratae, cum poris germinantibus; anamorphoses absentes vel ex arthroconidiis vel chlamydosporis constantes.

Ascospores globose or ellipsoid, black or dark colored, immersed or semiimmersed, rarely superficial, ostiolate or nonostiolate, solitary or aggregated, often crustaceous; asci globose or subclavate, evanescent, eight spored; ascospores dextrinoid in youth, smooth or with longitudinal ribs, fusoid or naviculate, pale or dark colored, with germination pores; anamorphs lacking or consisting of arthroconidia or chlamydospores.

Type genus: *Pithoascus* von Arx, Proc. Kon. Ned. Acad. Wetensch. Amsterdam, Ser. C, 76: 292. 1973. Two genera included.

Discussion: We propose the Pithoascaceae for those taxa of Microascales with arthroconidial anamorphs and narrowly fusoid or naviculate ascospores without germ pores. The dextrinoid ascospores and similar ascocarp structure and development suggest a relationship to the Microascaceae. We include two genera, *Pithoascus* and *Faurelina*. *Byssoascus* of the Gymnoascaceae (von Arx, 1971b), with its narrowly fusoid, straw-colored ascospores with longitudinal ribs and arthroconidial anamorph appears similar to *Faurelina*. They differ, however, in that *Byssoascus* develops asci from a crozier system and has very thin, light-colored peridial hyphae. Von Arx (1971b) acknowledged that *Byssoascus* did not appear to be related to other Gymnoascaceae, but he, like Barron and Booth (1966) who described the type, placed it there on superficial resemblances. Further study might prove that *Byssoascus* is a reduced form of Microascales.

The arthroconidial anamorphs of *Pithoascus* and *Faurelina* are very similar and appear to belong to *Arthrographis* (von Arx, 1978). Although the narrowly fusoid, ribbed ascospores of *Leuconeurospora* appear similar to those of *Faurelina*, the former differs in having unchained, globose asci, hyaline ascospores, and a cephalothecoid peridium. We concur with von Arx's (1978) decision to place *Leuconeurospora* in the Loculoascomycetes.

KEY TO THE GENERA OF PITHOASCACEAE

A. Ascospores smooth, straw to copper colored; ascocarps thicked walled, ostioles absent or inconspicuous, peridium often encrusted.................................*Pithoascus*
Type species: *P. nidicola* (Massee & Salmon) v. Arx, Proc. Kon. Ned. Acad. Wetensch. Amsterdam, Ser. C, 76: 292. 1973. Six species (see von Arx, 1973c, 1978).

AA. Ascospores with longitudinal ribs, light brown to copper; ascocarps elongate or pustulate, nonostiolate, peridium not encrusted.................................*Faurelina*
Type species: *F. fimigenes* Locquin-Linard, Rev. Mycol. 39: 127. 1975. Two species (see von Arx, 1978).

Chadefaudiellaceae Faurel & Schotter *ex* Benny & Kimbrough, *fam. nov.*

Chadefaudiellaceae Faurel & Schotter, *nomen nudum*, Compt. Rend. Hebd. Seances Acad. Sci. 249. 151. 1959 (without Latin diagnosis; Art. 36).

Ascocarpi elongati, nonostiolati, ex peridio pseudoparenchymate in substrato immerso et "capillitio" aerio constantes; asci catenulati, globosi vel clavati, evanescentes, octospori; ascosporae sinae poris germinantibus, nondextrinoideae; anamorphoses ignoti.

Ascocarps elongate, nonostiolate, consisting of a pseudoparenchymatous peridium embedded in the substrate and an aerial "capillitium"; asci catenulate, globose or clavate, evanescent, eight spored; ascospores without germination pores, nondextrinoid; anamorph unknown.

Type genus: *Chadefaudiella* Faurel & Schotter, Compt. Rend. Hebd. Seances Acad. Sci. 249: 152. 1959 (see also Faurel and Schotter, 1966; Faurel and Locquin, 1972). Only a single genus included.

Discussion: *Chadefaudiella* was originally described for a single species, *C. quezelii* Faurel & Schotter (1959), that was observed on gazelle dung collected at Koudou, Chad (Africa). In a more elaborate description (Faurel and Schotter, 1966), they showed that the fungus produces an elongate ascocarp with striate sides, setae that anastomose apically, a gleba with capillitia, globose, evanescent asci, and one-celled, fusiform ascospores. Although they repeated the description and Latin diagnosis provided in the earlier paper (Faurel and Schotter, 1959), additional illustrations were published in the second publication. A second species, *C. thomasii* Faurel & Locquin (1972), was described from dung collected in Algeria. Locquin-Linard (1973) later described and compared ascocarp development and ascus ontogeny in the two species of *Chadefaudiella*, clearly demonstrating that in *C. quezelii* the asci are formed in chains and that the ascospores are striate.

A second genus, *Faurelina*, described later was thought to be related to *Chadefaudiella* (Locquin-Linard, 1975). Parquey-LeDuc and Locquin-Linard (1976) studied the only species of *Faurelina*, *F. fimigenes*, and concluded that it belonged in the ascolocular Pyrenomycetes. Von Arx (1978) transferred the species into the Microascaceae because it produces dextrinoid ascospores. He also transferred *Leuconeurospora elongata* Udagawa & Furuya to *Faurelina*. We have treated *Faurelina* in the Pithoascaceae (see above).

Chadefaudiella, the only genus of the Chadefaudiellaceae, is placed in the Microascales because it produces asci in chains and has other characteristics of taxa of Microascaceae and Pithoascaceae. The ascospore wall of *C. quezelii* is striate as is the spore wall of *Faurelina fimigenes* (Locquin-Linard, 1973, 1975). Since the Latin diagnosis was not originally provided for Chadefaudiellaceae by Faurel and Schotter (1959) or subsequent workers, we have provided one above.

OPHIOSTOMATALES Benny & Kimbrough, *ord. nov.*

Ascocarpi ostiolati vel nonostiolati, globosi, pyriformes vel irregulares, interdum rostrati, fuscati, carbonacei, vel raro late colorati et carnosi; asci solitarii vel catenulati, globosi vel late ellipsoidei, octospori, irregulariter dispositi, deliquescentes; ascosporae unicellulae, variables, plerumque laeves, hyalinae vel luteolae, interdum striatae, a latere procatae, vel cum vagina gelatinosa, sine poris germinantibus, nondextrinoideae; anamorphoses variables ex phialoconidiis, blastoconidiis, annelloconidiis, vel sympoduloconidiis constantes; pleurumque in cellulosa viventi.

Ascocarps ostiolate or nonostiolate, globose, pyriform, or irregular, sometimes with an elongate beak, dark, carbonaceous, or rarely light colored and fleshy; asci solitary or catenulate, globose or broadly ellipsoid, irregularly disposed, eight spored, deliquescent; ascospores striate, laterally ridged, or with a gelatinous sheath, without germination pores, nondextrinoid; anamorphs variable, consisting of phialoconidia, blastoconidia, annelloconidia, or sympoduloconidia; mostly cellulosic

Only one family: Ophiostomataceae.

Ophiostomataceae Nannfeldt, Nova Acta Regiae Soc. Sci. Upsal., Ser. 4, 8(2): 30. 1932 (with the characteristics of the order).

Discussion: Three genera have historically been placed in the Ophiostomataceae: *Ceratocystis* Ellis & Halst., *Europhium* Parker, and *Sphaeronaemella* Karst. *ex* Seeler. The type of the family, *Ophiostoma* Syd., was considered a later homonym of *Ceratocystis* by Hunt (1956) who monographed the genus. Article 10 of the International Code of Botanical Nomenclature (Stafleu, 1972) obviates any change in the family name. *Ceratocystis* is the largest genus and is of great economic importance because of plant pathogenic or wood-staining species. Recent treatments of the genus have utilized ascospore morphology as a criterion to separate the genus into smaller groups (Griffin, 1968; Olchowecki and Reid, 1974). Von Arx (1974a), however, suggested that species with a *Chalara*-type anamorph should be retained in *Ceratocystis* but those species with blastoconidia in sympodulae should transferred to *Ophiostoma*. *Europhium*, considered the cleistothecial counterpart of *Ophiostoma*, was maintained as a distinct genus by von Arx (1974a, 1974b). Both *Europhium* and *Ophiostoma* are condidered synonyms of *Ceratocystis* by Upadhyay and Kendrick (1975). We consider *Europhium* to be a synonym of *Ophiostoma*.

Von Arx (1974a) thought that several of the yeastlike genera that produce asci on ascophores, *i.e.*, *Ambrosiozyma*, *Cephaloascus*, *Botryoascus*, and *Hormoascus*, were related naturally to the Ophiostomataceae. The latter three taxa formed chains of asci that resembled conidia of *Verticicladiella*, a common anamorph in this family. Weijman and de Hoog (1975) support the separation of *Ceratocystis* and *Ophiostoma sensu* von Arx. They found that rhamnose was present in the walls of *Ophiostoma*, but not in *Ceratocystis*. This correlates well with the types of anamorphs and the presence of cellulose in species of these genera (Jewell, 1974). See table below:

Genus	Group[1]	Rhamnose[2]	Cellulose[3]	Anamorphs[4]
Ceratocystis	*Fimbriata*	-	-	Enteroblastic Phialidic
Ophiostoma	*Pilifera*, *Ips*, *Minuta*	+	+	Holoblastic Annello- or Sympoduloconidia

[1] Based on ascospore characters of *Ceratocystis sensu* Olchowecki and Reid, 1974; [2] Weijman and de Hoog, 1975; [3] Jewell, 1974; [4] Upadhyay and Kendrick, 1975.

Upadhyay and Kendrick (1975) described four new anamorphs associated with *Ceratocystis* (inclusive of *Europhium* and *Ophiostoma*), making the total number of anamorphic genera 16, the highest known for any genus. They also described a new ascomycete genus, *Ceratocystopsis*, based upon Olchowecki and Reid's (1974) *Minuta* group of *Ceratocystis*.

Recently, Redhead and Malloch (1977) have greatly expanded the concepts of Cain (1972) and von Arx (1974a), who believed that members of the Ophiostomataceae appear to be related to cellular and filamentous yeastlike taxa. In addition to *Ceratocystis*, *Europhium*, *Ophiostoma*, and *Ceratocystopsis*, Redhead and Malloch accepted the cleistothecoid *Amorphotheca*, and the cellular or filamentous, yeastlike genera *Ambrosiozyma*, *Ascoidea*, *Botryoascus*, *Cephaloascus*, *Endomyces*, *Hansenula*, *Hormoascus*, *Hypopichia*, *Pachysolen*, *Phialoascus*, and *Stephanoascus*. They felt that most of these genera have in common the formation of galeate ascospores, an insect association, growth in plant exudates, blastoconidial anamorphs, and globose to broadly clavate asci that do not arise from croziers. *Amorphotheca* was included because its blastoconidial anamorph, *Hormoconis resinae* (Lindau) v. Arx & de Vries (=*Hormodendron resinae* Lindau), resembled that of *Ambrosiozyma monospora* (Saito) van der Walt. With the inclusion of *Endomyces* and similar yeastlike genera in the Ophiostomataceae, they chose the family name Endomycetaceae since it had priority.

While Redhead and Malloch's proposal has some merit and certainly should be considered, their ideas are based upon morphology of the organisms as observed with the light microscope and do not include any data available on the ultrastructure or chemical analysis of hyphal, ascal, and spore walls. Valuable data on septal ultrastructure in many Hemiascomycetes must be analysed when proposing natural groups such as the Endomycetaceae. Four distinct septal types are known for the filamentous yeasts that may indicate natural lines of evolution (Kreger-van Rij and Veenhuis, 1973; Kurtzman, 1977). They are: (1) the dolipore type present in *Ambrosiozyma* spp. (Kreger-van Rij and Veenhuis, 1973); (2) the multiperforate type present in *Botryoascus*, *Endomycopsis*, *Saccharomycopsis* (Kreger-van Rij and Veenhuis, 1973), *Endomyces* (Kreger-van Rij and Veenhuis, 1972), and *Dipodascus* (Kreger-van Rij and Veenhuis, 1974); (3) a single narrow pore not plugged by Woronin bodies in *Endomycopsis*, *Arthroascus*, *Saccharomycopsis* (Kreger-van Rij and Veenhuis, 1973), and *Dipodascopsis* (Kreger-van Rij and Veenhuis, 1974); and (4) a typical ascomycetous septum plugged with Woronin bodies in *Cephaloascus* (Kurtzman, 1977).

Multiperforate septa occur, with some variations, in members of the Mucorales and Chytridiales (Gull, 1978). The septum with a single, central perforation plugged or surrounded by Woronin bodies is the type present in essentially all of the Ascomycetes and Deuteromycetes (Gull, 1978; Benny and Samuelson, 1980). On this basis we exclude all genera without the ascomycetous septum from the Ophiostomataceae. Since the genus *Endomyces*, including the type *E. decipiens* Reess, has multiperforate septa (Kreger-van Rij and Veenhuis, 1972), *Endomyces* and the family name Endomycetaceae must be excluded from the *Ceratocystis-Ophiostoma* complex. Hawes and Beckett (1977) have shown that *Chalara* sp., the anamorph of *Ceratocystis* *adiposa* (Butler) C. Moreau, has the typical ascomycetous septum. *Botryoascus*, also with the multiperforate septum, should be excluded from the family. Weijman (1975) has shown that *Botryoascus* and *Ceratocystis* have a different wall chemistry and also (Weijman, 1976) that on the basis of wall chemistry *Cephaloascus* was not related to *Ophiostoma* or *Europhium*. *Cephaloascus* can also be separated from *Ceratocystis* because of distinctly different anamorphs. For these reasons we exclude *Cephaloascus* from the Ophiostomataceae. *Ambrosiozyma* does not belong here because four species have a dolipore like septum reminiscent of certain basidiomycetes (Kreger-van Rij and Veenhuis, 1972, 1973; Flegler *et al.*, 1976; Gull, 1978). We believe that septal ultrastructure is useful in tracing phylogeny and relationships in Ascomycetes as has been done in Basidiomycetes (Moore, 1977, 1978; Tu and Kimbrough, 1978; Khan and Kimbrough, 1980).

A number of students have included *Sphaeronaemella* in the Ophiostomataceae (Dennis, 1968; Müller and von Arx, 1973), although von Arx and Müller (1954) believed earlier that it was a relative of Melanosporaceae with colorless ascospores. From a study of *S. fimicola* Marc. in culture, Cain and Weresub (1957) concluded that it was closely related to *Ceratocystis* but it should be included in the Hypocreaceae because of the structure and color of the ascocarps. Malloch (1974b) transferred two species of *Viennotidia* (Hypocreales) to *Sphaeronaemella* and provided a key to the four recognized species. He felt that the genus was unrelated to *Ceratocystis*, and in a later paper placed it in the Nectriaceae (Malloch, 1979). While we agree that similarities in anamorphs and ascocarp pigmentation suggest a relationship to the Hypocreales, we would restrict the Nectriaceae to taxa in which the asci remain persistant and possess an apical pore apparatus. Almost all of the Nectriaceae have two-celled ascospores, a feature not found in *Sphaeronaemella*.

Subbaromyces (Hesseltine, 1953) and *Chadefaudia* (Feldmann, 1957) have also been placed in the Ophiostomataceae. *Subbaromyces* was placed here because the ascocarps had long beaks composed of parallel hyphae, a centrum without paraphyses, and broadly clavate, deliquescent asci (Cole *et al.*, 1974). Ascospores of *S. splendens* Hesselt. are two celled and are surrounded by a gelatinous sheath, the asci are very elongate and they form from a basal cluster, they are thick walled in youth and are apically thickened. These features are suggestive of Loculoascomycetes.

Chadefaudia was included in the Ophiostomataceae by Feldmann (1957) because its asci were irregularly disposed in the centrum. Kohlmeyer (1972) examined the type of *Chadefaudia*, *C. marina* Feldmann, and found that the asci were formed in a hymenial layer, became detached early in their development, and were forced into the centrum during the maturation process giving the appearance of being irregularly disposed. We concur with Kohlmeyer's placement of this genus in the Halosphaeriaceae.

With the exclusion of the aforementioned genera and the synonymy of *Europhium*, four genera remain. They can be distinguished in the following key:

KEY TO THE GENERA OF OPHIOSTOMATACEAE

A. Ascocarps fleshy, bright or light colored................................*Sphaeronaemella*
Type species: *S. helvellae* (Karst.) Karst. *ex* Seeler, Farlowia 1: 127. 1943. Four species known (see Malloch, 1974b for key)

AA. Ascocarps typically dark and crustose................B

B(AA). Ascospores elongate, sheathed, sheath attenuated at the ends...*Ceratocystopsis*
Type species: *C. minuta* (Siem.) Upadhyay & Kendrick, Mycologia 67: 800. 1975 (eventually will include the *Minuta* group of *Ceratocystis* [see Olchowecki and Reid, 1974]).

BB(AA). Ascospores not as above......................C

C(BB). Ascospores short, curved, lunate, or naviculate, sheathed; anamorphs enteroblastic and phialidic; no cellulose or rhamnose in cell walls..............*Ceratocysis*
Type species: *C. fimbriata* Ellis & Halst., N.J. Agr. Exp. Sta. Bull. 76: 14. 1890. Many species (see Olchowecki and Reid, 1974 for keys to the species in the *Fimbriata* group of *Ceratocystis*).

CC(BB). Ascospores not as above, sheathed or not sheathed; anamorphs holoblastic, sympodial, or annellidic; cellulose and rhamnose in cell walls..............*Ophiostoma*

Type species: O. *pilifera* (Fr.) Sydow
& Sydow, Ann. Mycol. 17: 43. 1919.
Many species known (see Olchowecki
and Reid, 1974 for keys to species
in the *Ips* and *Pilifera* groups of
Ceratocystis). Syn.: *Europhium* Parker.

AN ANNOTATED LIST OF CLEISTOTHECIAL ASCOMYCETES

Within the past two decades numerous studies on the biology and taxonomy of Ascomycetes have shown that many cleistothecial taxa represent a reduced or modified form of perithecial, apothecial, or pseudothecial groups. The list below summarizes these studies and expresses our view as to where these genera, with current knowledge, belong.

Actinodendron--a monotypic genus described in the Gymnoascaceae by Orr and Kuehn (1963a) but rejected by Hughes (1968) who found that it was based on the hyphomycete *Oncocladium flavum*.

Ajellomyces--included here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Albertinella--based on A. *reticulata* Kirsch. but a second species, A. *polyporicola* (Jacz.) Malloch & Cain (1972a) has been added and the genus was placed among those taxa "of unknown affinities." Malloch (1970b) notes that a final disposition will await the determination of the presence or absence of germ pores in the ascospores. The absence of germ pores would suggest a relationship to the Cephalothecaceae. Udagawa and Horie (1971a) illustrated A. *polyporicola* as *Cephalotheca splendens* Udagawa & Horie (see Malloch and Cain, 1972a; Malloch, 1979).

Allescheria--We are following Malloch (1970a) in considering this genus a synonym of *Petriellidium*. Von Arx (1974b) considers *Allescheria gayonii* (Cost.) Sacc. & Syd. to be a synonym of *Monascus ruber* van Tiegh.

Amauroascus--included here in the Arachnioideae of the Gymnoascaceae (Onygenales).

Amorphotheca--a monotypic genus based upon *Amorphotheca resinae* Parbery (1969), the teleomorph of *Hormoconis resinae* (von Arx, 1973a). Parbery (1969) included A. *resinae* in a separate family, Amorphothecaceae (Eurotiales), a position accepted by Barr (1976). Fennell (1973) suggested a relationship with the Hemiphacidiaceae (Helotiales), and Redhead and Malloch (1977) placed it in the Ophiostomataceae (their Endomycetaceae) where it has been retained by Malloch (1979) because its anamorph is similar to that of

Ambrosiozyma. We are excluding *Amorphotheca* from the Plectomycetes for reasons given in the discussion of the Ophiostomataceae. It is probably a reduced discomycete as was suggested by Fennell (1973).

Amylocarpus--a marine fungus that is thought by Malloch (1970b) to be a member of the Hypocreaceae or Nectriaceae (Hypocreales), although it has been placed in the Aspergillaceae or Eurotiaceae (Trichocomaceae here) by Fennell (1973) and Kohlmeyer (1960; as *Plectolitus*). Lack of an anamorph in *A. encephaloides* Curr. hampers establishment of a closer relationship with the Trichocomaceae. *Plectolitus* Kohlm. is considered a synonym (Kohlmeyer and Kohlmeyer, 1971).

Anixiella--according to Muller and von Arx (1973) and Malloch and Cain (1971d), *Anixiella* (Cain, 1961b) is the cleistothecial counterpart of *Gelasinospora* (Sordariaceae). Species illustrated by Cain (1961b), Udagawa (1965), Udagawa, Furuya, and Horie (1973), Horie and Udagawa (1974), Mukerji and Saxena (1974), and Furuya and Udagawa (1977). Uecker (1979) has studied the the cytology and ascocarp ontogeny in *Anixiella endodonta* Malloch & Cain.

Anixiopsis--treated here in the Onygenaceae (Onygenales).

Aphanoascus--treated here in the Trichocomaceae (Eurotiales).

Apinisia--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Apodus--members of this genus have ovoid to cylindrical asci with an apical pore. Malloch and Cain (1971d) included *A. deciduus* Malloch & Cain in the Sordariaceae. Von Arx (1975a) described a second species, *A. oryzae* De Carolis & v. Arx, and suggested a relationship to *Zopfiella*.

Aposphaeriopsis--a synonym of *Cephalotheca* (*q.v.*) according to Chesters (1934). Malloch (1970b) discusses the genus in detail.

Aporothielavia--treated here in the Cephalothecaceae (Eurotiales).

Arachniotus--treated here in the Arachnioideae of the Gymnoascaceae (Onygenales). Species illustrated by Udagawa (1963b, 1970) and Udagawa and Takada (1968).

Arachnomyces--treated here in the Onygenaceae (Onygenales).

Arachnotheca--treated here in the Arachnioideae of the Gymnoascaceae (Onygenales).

Argynna--treated among the genera of unknown affinities by Malloch (1970b). *Argynna polyhedron* (Schw.) Morg. has a cephalothecoid peridium and, therefore, was placed in the Cephalothecaceae by von Höhnel (1917). Malloch and Cain

(1970b) excluded it from this family, however, since they felt that peridial type was not a stable family character. Martin (1941b) found long, stipitate, broadly clavate asci, and two-celled ascospores in material grown in culture. Von Arx (1971a) placed *Argynna*. *Lepidosphaeria*, *Neotestudina*, *Pseudophaeotricum*, and *Testudina* in the Testudinaceae as did von Arx and Müller (1975). Hawksworth and Booth (1974) treated the Testudinaceae as a synonym of the Zopfiaceae and all of the above genera except *Argynna* as synonyms of *Zopfia*. Further work must be done before affinities of this genus can be determined. Ainsworth (1971) placed *Argynna* in the Meliolales.

Arrhenosphaera--treated here in the Ascosphaeraceae (Ascosphaeraceae).

Arthroderma--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Ascocalvatia--treated here in the Onygenaceae (Onygenales).

Ascorhiza--treated here in the Monascaceae (Ascosphaerales).

Ascoscleroderma--treated here as a synonym of *Elaphomyces* (*q.v.;* see Trappe, 1979)(Elaphomycetales).

Ascosphaera--treated here in the Ascosphaeraceae (Ascosphaerales).

Auxarthron--treated here in the Gymnoascoideae of the Gymnoascaceae (Onygenales).

Backusia--treated here as a synonym of *Monascus* (Monascaceae; Ascosphaerales).

Batistia--a genus of uncertain affinities (see also Malloch, 1970b). *Batistia annulipes* (Mont.) Ciferri has a cephalothecoid peridium and, therefore, was included in the Cephalothecaceae *sensu* von Höhnel (1917) when originally described by Ciferri (1958). Ciferri proposed a monogeneric tribe, the Batistieae, because the ascocarp of *B. annulipes* was woody and stipitate, and the peridium was relatively thick, whereas, other members of the family had carbonaceous, sessile ascocarps with a relatively thin peridium.

Battarrina--considered a member of the Nectriaceae (Hypocreales) by Malloch (1970b). The sole species, *B. inclusa* (Berk. & Br.) Clements & Shear, is parasitic on ascocarps of *Tuber puberulum* Berk. & Br. (Hawker, 1955). It was originally described as a subgenus of *Hypocrea*.

Bettsia--treated here in the Ascosphaeraceae (Ascosphaerales).

Bombardia--a member of the Sordariaceae according to Müller and von Arx (1973) and Lundqvist (1972). The cleistothecia are clavate and the asci are typically sordariaceous.

Boothiella--according to von Arx (1974b, 1975a), *Boothiella* Lodhi & Mirza (1962) is a synonym of *Thielavia*.

Byssoascus--treated here in the Arachnioideae of the Gymnoascaceae (Onygenales).

Byssochlamys--treated here in the Trichocomaceae (Eurotiales).

Capsulotheca--considered a genus of unknown affinities by Malloch (1970b), although he suggested a possible relationship to the Pseudeurotiaceae. Von Arx (1974b) considered it a synonym of *Emericellopsis*.

Carothecis--a genus based upon *Cephalotheca palearum* Rich. (Clements and Shear, 1931) and thought to be a possible synonym of *Cephalotheca* by Ainsworth (1971). Malloch (1970b) could not locate herbarium material and, therefore, was not able to place the genus.

Carpenteles--treated here as a synonym of *Eupenicillium* (*q.v.*)(see von Arx, 1974b).

Celtidia--a monotypic genus, *Celtidia duplicispora* Janse, was synonymized with *Zopfia* by Malloch and Cain (1972a) and retained there by Hawksworth and Booth (1974). Hawksworth (1979) recognized *Celtidia* as a genus of the Testudinaceae.

Cenococcum--treated here as the anamorph of *Elaphomyces* (Trappe, 1971). The mycorrhizal mantles of the anamorphs and teleomorphs are identical.

Cephalotheca--treated here in the Cephalothecaceae (Eurotiales).

Ceratocarpia--included in the Eurotiales by Clements and Shear (1931) and Ainsworth (1971); although cleistothecial, ascospores of *C. cactorum* Rolland (1896) are muriform, a characteristic that best places this genus in the Loculoascomycetes (Luttrell, 1973).

Ceratocystis--treated here in the Ophiostomataceae (Ophiostomatales).

Ceratocystopsis--treated here in the Ophiostomataceae (Ophiostomatales).

Chadefaudia--originally placed in the Ophiostomataceae by Feldmann (1957) and recently transferred to Halosphaeriaceae by Kohlmeyer (1972). See the discussion under Ophiostomatales for details.

Chadefaudiella-treated here under the Chadefaudiellaceae (Microascales).

Chaetomidium--a member of the Chaetomiaceae classically defined as producing cleistothecia with hairs. It was combined with *Thielavia* (*q.v.*) by Malloch and Cain (1973a) but

but *Chaetomidium* was retained as a separate genus by von Arx (1975a) based on differences in peridial wall cells, ascospore morphology, and presence of ascocarp hairs. Von Arx (1975a), who provided a key to six species, considers *Chaetomidium* to be the cleistothecial counterpart of *Chaetomium*. New species have been described by Lodha (1974a) and Benny (1980), and illustrations have been provided by Furuya and Udagawa (1975; as *Thielavia*).

Chaetosartorya--treated here in the Trichocomaceae (Eurotiales).

Chaetotheca--treated as a genus of uncertain affinities by Malloch (1970b). *Chaetotheca fragilis* Zukal was transferred to *Cephalotheca* by Fischer (1897).

Cleistobombardia--described by Mirza in 1968 but considered a synonym of *Tripterosporella* (*q.v.*) by Malloch (1970b).

Cleistosoma--described by Harkness (1885) but considered a synonym of *Emericella* by Peek and Solheim (1958).

Cleistotheca--described by Zukal (1890), but according to Ainsworth (1971) it is a synonym of *Pleospora*.

Cleistothelebolus--the type, *C. nipigonensis* Malloch & Cain, was placed initially in the Thelebolaceae (Malloch, 1970b), later in the Eoterfeziaceae (Malloch and Cain, 1971b), and eventually in the Pyronemataceae (Malloch, 1979). Samuelson and Kimbrough (1978) have shown that *Thelebolus* is related more closely to the Loculoascomycetes. We would exclude *Cleistothelebolus* from the Pyronemataceae based upon recent cytological and ultrastructural evidence (Samuelson and Kimbrough, 1978) although Jeng and Krug (1976) still retain it in the Theleboleae of the Pyronemataceae.

Coniochaetidium--the cleistothecial counterpart of *Coniochaeta* of the Coniochaetaceae (Sordariales) according to Malloch and Cain (1971b) and von Arx (1975b). Von Arx provides a key to species and illustrations of species are given in Udagawa and Furuya (1975).

Connersia--treated here in the Cephalothecaceae (Eurotiales). *Connersia* Malloch (1974a) is a monotypic genus based upon *Pseudeurotium rilstonii* Booth (1961).

Copromyces--described by Lundqvist (1967) and included in the Sordariaceae. It is cleistocarpous with clavate, evanescent asci that lack an apical ring, and contain one to three warty, dark ascospores.

Corynascus-- based upon *Thielavia sepedonium* Emmons, the genus as concieved by von Arx (1973b) has a dark cleistothecial wall of irregular, thick-walled, flattened cells, ascospores with two germ pores, and a *Chrysosporium* or *Se-*

pedonium anamorph. Von Arx (1975a) later added another species, *C. setosus* (Dade) v. Arx, and provided a key to the four species recognized.

Corynascella--members of this genus produce ascospores with de Bary bubbles, walls with thickened ends perforated by a germ pore, and a light colored cleistothecium covered with dark hairs. The genus is based upon a single species, *C. humicola* v. Arx & Hodges (von Arx, 1975a). Additional species have been placed in *Corynascella* by von Arx (1975b) and Udagawa and Ueda (1979). It has sordariaceous affinities and appears to be related to *Thielavia*.

Crepinula--treated here as a synonym of *Cephalotheca* (Malloch, 1970b; Ainsworth, 1971).

Cryptendoxyla--treated here in the Cephalothecaceae (Eurotiales).

Ctenomyces--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Dactylomyces--treated here in the Trichocomaceae (Eurotiales).

Dendrosphaera--treated here in the Dendrosphaeraceae (Onygenales).

Dexteria--placed in the Eurotiales by Clements and Shear (1931). It produces elongate, septate ascospores, and the asci appear to be bitunicate; all chacteristics suggestive of the Loculoascomycetes.

Dichlaena--treated here in the Trichocomaceae (Eurotiales).

Dichotomomyces--treated here in the Onygenaceae (Onygenales). Illustrations provided by Udagawa (1970).

Didymium--a synonym of *Orbicula* (*q.v.*) according to Malloch (1970b).

Diehliomyces--treated here in the Onygenaceae (Onygenales).

Diplogelasinospora--described by Cain (1961b) for a sordariaceous species that produced nonostiolate ascocarps. An additional species was proposed by Udagawa and Horie (1972b), and illustrations were provided by Udagawa, Furuya, and Horie (1973).

Diplostephanus--a synonym of *Emericella* (*q.v.*) according to Raper and Fennell (1965).

Disarticulatus--treated here as a synonym of *Arachniotus* (von Arx, 1977b). Originally described by Orr (1977c).

Echinopodospora--this genus, proposed by Robinson (1970), is closely allied to *Zopfiella* (Sordariaceae) according to von Arx (1974b). New species were described by Morinaga *et al.* (1978) and Jong and Davis (1974), and illustrations were provided by Udagawa, Furuya, and Horie (1973).

Edyuilla--treated here in the Trichocomaceae (Eurotiales). A synonym of *Eurotium* (*q.v.*) according to Samson (1979).

Eidamella--treated here as a synonym of *Myxotrichum* (Orr *et al.*, 1963c), although it was recognized as a valid genus by Benjamin (1956a).

Eiona--a cleistocarpous marine genus found in Denmark and described by Kohlmeyer (1963). The top of the ascocarp deliquesces and it appears apothecoid at maturity. The ascospores have hyaline appendages at their tips (Kohlmeyer, 1968). Malloch (1970b) included the genus in the Halosphaeriaceae although Kohlmeyer (1972) did not place it there when he revised the family.

Elaphomyces--treated here in the Elaphomycetaceae (Elaphomycetales).

Eleutherascus--in our opinion this fungus is a reduced discomycete close to *Ascodesmus* (Pezizales; Jeng and Cain, 1976b), even though it has normally been placed in the Gymnoascaceae. Species illustrated by Udagawa and Horie (1975). *Eleutherascus* was described by von Arx (1971b) and additional species were proposed by van Emden (1975), Huang (1975), and Samson and Luiten (1975). A member of this genus was made the type of *Hemiascosporium* and included in the Hemiascomycetes (Batra, 1973; see also the discussion under the Gymnoascaceae).

Emericella--treated here in the Trichocomaceae (Eurotiales).

Emericellopsis--treated here in the Cephalothecaceae (Eurotiales). It has had from two to nine species recognized (Malloch and Cain, 1970b; von Arx, 1974b). Illustrations provided by Udagawa (1963b).

Emmonsiella--treated here as a synonym of *Ajellomyces* (McGinnis and Katz, 1979).

Enterocarpus--treated here in the Microascaceae (Microascales).

Eoterfezia--a genus based on *E. parasitica* Atkinson (1902) was found parasitizing a coprophilic *Sordaria*. It produces many clavate asci enclosed in a thin, membranous, undifferentiated peridium. It was made the type of the Eoterfeziaceae (Atkinson, 1902), a family later expanded by Malloch and Cain (1971b) to include *Cleistothelebolus*, *Lasiobolidium*, *Microeurotium*, *Orbicula*, and *Xeromyces*. Malloch (1970b) had initially placed these taxa in the Thelebolaceae but subsequently they have been transferred to the Pyronemataceae (Jeng and Krug, 1976; Malloch, 1979). A second species was described by Jeng and Cain (1976a). Final disposition of this genus will await the publication of additional data on cytology and development.

Ephemeroascus--a genus described by van Emden (1973) that is characterized by the formation of one-celled, brown ascospores with germ slits, a cleistothecium with a pseudoparenchymatous peridium, and a *Verticillium*-like anamorph. Van Emden placed *Ephemeroascus* in the Eurotiales but noted its similarity to the Coniochaetaceae. Von Arx (1975a) stated that the anamorph was typical of that of a number of species of *Nectria*, but was not able to determine the relationships of *Ephemeroascus*. We agree with Malloch's (1979) placement of this taxon in the Coniochaetaceae.

Eremodothis--this monotypic genus, proposed by von Arx (1975b), was based upon *Thielavia angulara* Das. It differed from other species of *Thielavia* in producing tuberiform cleistothecia and ascospores without germ pores. Malloch and Cain (1973a) did not include *Eremodothis angularis* (Das) v. Arx in *Thielavia* nor did they state where it should be placed.

Eupenicillium--treated here in the Trichocomaceae (Eurotiales). Species illustrated by Udagawa (1965 as *Carpenteles*, 1968, 1970), Udagawa and Awao (1969), Udagawa and Horie (1972c, 1973a, 1973b, 1974), Udagawa and Takada (1968), and Udagawa, Furuya, and Horie (1973).

Europhium--treated here in the Ophiostomataceae (Ophiostomatales) as a synonym of *Ophiostoma*.

Eurotiella--a synonym of *Allescheria* (*q.v.*) according to Ainsworth (1971) and Malloch (1970b).

Eurotiopsis Cost.--a synonym of *Allescheria* according to Ainsworth (1971) and Malloch (1970b). *Eurotiopsis* Karst. is a possible member of the Eurotiales (Ainsworth, 1971).

Eurotium--treated here in the Trichocomaceae (Eurotiales).

Fairmania--the type species, *Fairmania singularis* Sacc., was found to be identical to *Microascus doguetii* Moreau and Malloch and Cain (1971c) changed the name to *Microascus singularis* (Sacc.) Malloch & Cain. Von Arx (1975c) also accepted *M. singularis* as a valid species in his monograph of *Microascus*.

Faurelina--treated here in the Pithoascaceae (Microascales). *Leuconeurospora elongata* Udagawa & Furuya was transferred to *Faurelina* by both von Arx (1978) and Furuya (1978). Although the new combination is credited to Furuya, as *Faurelina elongata* (Udagawa & Furuya) Furuya, there is some question concerning which publication has priority (see Index of Fungi 4(18): 564. 1979).

Fennellia--treated here in the Trichocomaceae (Eurotiales).

Fleishhakia Auerswald--according to Cain (1961a) this is a synonym of *Preussia* (*q.v.*).

Fragosphaeria--treated here in the Cephalothecaceae (Eurotiales). Illustrated by Eliasson (1971).

Galactomyces--according to Redhead and Malloch (1977) this genus is a member of the Onygenaceae that lacks an ascocarp. Two species are included that were previously described in *Endomyces*, *E. geotrichum* and *E. reessii*. These fungi were both transferred to *Dipodascus* by von Arx (1977a).

Germslitospora--according to Lodha (1978) this monotypic genus, based upon *Thielavia savoryi* Booth, belongs in the Coniochaetaceae (Sordariales; Malloch and Cain, 1971d). Von Arx (1975a) earlier had transferred *T. savoryi* to *Coniochaetidium* (*q.v.*) but Udagawa and Furuya (1979) consider *Germslitospora* to be a valid genus.

Guilliermondia Boud.--a member of the Eurotiales according to Ainsworth (1971). It produces paraphyses and long stipitate asci from a basal hymenium, and dark ascospores (Boudier, 1904); all characters suggestive of the Sordariaceae. Malloch (1979), however, places the genus in the Ascobolaceae (Pezizales).

Gymnascella--treated here as a synonym of *Gymnoascus* (*q.v.*). Von Arx (1977b) believes that the type, *Gymnascella aurantiaca* Peck, is identical to *Gymnoascus reessii*. Orr, Ghosh, and Roy (1977) transferred three species of *Arachniotus* (*q.v.*) to *Gymnascella*.

Gymnoascoideus--treated here as a synonym of *Gymnoascus* (*q.v.*) according to von Arx (1977b) who spelled the name *Gymnoascoides*. *Gymnoascoideus* was originally described as a monotypic genus by Orr, Roy, and Ghosh (1977).

Gymnoascopsis--a member of the Eurotiales according to Ainsworth (1971).

Gymnoascus--treated here in the Gymnoascoideae of the Gymnoascaceae (Onygenales). Species illustrated by Udagawa (1963b, 1966).

Gymnoeurotium--treated here as a synonym of *Edyuilla* (*q.v.*)(see Malloch and Cain, 1973b). Von Arx (1974b) and Samson (1979) believe, however, that *Gymnoeurotium* is a synonym of *Eurotium* (*q.v.*).

Hamigera--treated here in the Trichocomaceae (Eurotiales). Species illustrated by Udagawa and Horie (1972c) and Udagawa and Takada (1967; as *Talaromyces*).

Hapsidospora--treated here in the Cephalothecaceae (Eurotiales).

Harpezomyces--treated here as a synonym of *Chaetosartor*-

ya (see Malloch and Cain, 1973b; von Arx, 1974b; Samson, 1979).

Heleococcum--Malloch (1970b) placed the genus in the Nectriaceae. Two species, *H. aurantiacum* Jørg. and *H. japonese* Tubaki have been described, both having two-celled ascospores. We restrict the Plectomycetes to those taxa that produce unicelled ascospores.

Hemiascosporium--treated here as a synonym of *Eleutherascus* (von Arx, 1971b); see the discussions under the Gymnoascaceae and *Eleutherascus* in this section.

Hemicarpenteles--treated here in the Trichocomaceae (Eurotiales). Species illustrated by Udagawa and Takada (1971).

Hemisartorya--treated here in the Trichocomaceae (Eurotiales). *Hemisartorya* Rai & Chowdhery (1975) closely resembles *Neosartorya* (*q.v.*). Samson (1979) believes that *Hemisartorya* may be based on a mixed culture, one component of which he identified as *Neosartorya fischeri* (Wehm.) Malloch & Cain. More study is needed in order to confirm Samson's observation.

Hexagonella--according to Ainsworth (1971) this genus is a member of the Eurotiales.

Honoratia--a synonym of *Preussia* according to Ainsworth (1971).

Inzengaea--a synonym of *Emericella* (*q.v.*) according to Raper and Fennell (1965).

Keratinophyton--treated here in the Onygenaceae (Onygenales).

Kernia--treated here in the Microascaceae (Microascales). It is the cleistothecial counterpart of *Petriellidium* (*q.v.*) (see Malloch and Cain, 1971c).

Kuehniella--treated here as a synonym of *Arachnotheca* (*q.v.*)(von Arx, 1977b).

Laasiomyces--according to Ainsworth (1971) this genus is a member of the Eurotiales. Malloch (1970b), however, found ostioles in the type material of *Laasiomyces microscopicus* Ruhl and excluded it from his studies. The ascocarps resemble those of *Ceratostoma caulincola* Fckl.

Lasiobolidium--originally placed in the Thelebolaceae by Malloch (1970b) but the genus was later placed in the Eoterfeziaceae by Malloch and Cain (1971b). *Lasiobolidium* was recently transferred to the Pyronemataceae by Jeng and Krug (1976). Although initially monotypic a second species, *L. orbiculoides* Malloch & Benny (1973), was described later.

Leiothecium--treated here in the Monascaceae (Ascosphaerales).

Leuconeurospora--treated here as a member of the Loculoascomycetes. *Leuconeurospora* Malloch & Cain (1970b) was originally described as a monotypic member of the Pseudeurotiaceae (=Cephalothecaceae here), based upon *Eurotium pulcherrimum* Wint. A second species, *L. elongata* Udagawa & Furuya (1973), was added that has since been transferred to *Faurelina* (*q.v.*) by two authors (von Arx, 1978; Furuya, 1978).

Leucosphaera--treated here in the Cephalothecaceae (Eurotiales).

Leucothecium--treated here in the Onygenaceae (Onygenales).

Levispora--according to Malloch (1970b), *L. terricola* Rout. is a synonym of *Pseudeurotium zonatum* van Beyma.

Lilliputia--Malloch and Cain (1972a) consider *Lilliputia* (Hughes, 1951) to be a synonym of *Roumegueriella* (*q.v.*).

Lophotrichus--treated here in the Microascaceae (Microascales). Species illustrated by Furuya and Udagawa (1973).

Macronodus--treated here as a synonym of *Gymnoascus* (*q. v.*)(see von Arx, 1977b). Orr (1977a) proposed *Macronodus* for a species with swollen peridial septa (as in *Auxarthron*, *q.v.*). but with different ascospore morphology and appendage branching. Orr provides a key to the species of both *Auxarthron* and *Macronodus*.

Magnusia--a synonym of *Kernia* according to Benjamin (1956b).

Marchaliella--according to von Arx (1971b), Hawksworth and Booth, and Hawksworth (1979), this genus is a synonym of *Testudina*

Melanocarpus--a genus created for *Myriococcum albomyces* Cooney & Emerson, a thermophilic, cleistothecial ascomycete. Although *M. albomyces* was transferred to *Thielavia* (*q.v.*) by Malloch and Cain (1972a), von Arx (1975a) says that it is not related to either *Chaetomidium* or *Thielavia*. Von Arx placed *Myriococcum albomyces* in a genus of its own, *Melanocarpus*, that appears to be related to members of the Sordariaceae.

Mesophellia--placed in the tribe Mesophellieae of the Elaphomycetaceae by Dodge (1929). According to Dring (1973), however, it belongs in the Gasteromycetes (see our discussion under the Elaphomycetales).

Microascus--treated here in the Microascaceae (Microascales). Species illustrated by Udagawa and Awao (1969) and Udagawa (1962, 1963a).

Microeurotium--the type, *Microeurotium albidum* Ghatak (1936), was first isolated as a laboratory contaminant. It was placed in the Thelebolaceae by Malloch (1970b) and later transferred to the Eoterfeziaceae (Malloch and Cain, 1971b). The ascus arises directly from an ascogonial cell and it is persistant as in members of the Thelebolaceae. Von Arx (1974b), however, considers *Microeurotium* and *Xeromyces* to be synonyms of *Monascus*. Recently, Jeng and Krug (1976) and Malloch (1979) placed other Eoterfeziaceae, including *Microeurotium*, in the Pyronemataceae (Jeng and Krug place these fungi in the tribe Theleboleae of the Pyronemataceae).

Microthecium--the cleistothecial counterpart of *Melanospora* according to Müller and von Arx (1973). Von Arx (1973b) considered it a synonym of *Melanospora*, although Udagawa and Takada (1974) noted that other than the lack of an ostiole also there are differences in spore ornamentation. Udagawa and Cain (1969) and Hawksworth and Udagawa (1977) monographed the genus and the latter authors provided a key to species. We retain *Microthecium* in the Melanosporaceae (Sphaeriales). Species were illustrated by Horie and Udagawa (1973b) and Udagawa and Horie (1971b).

Monascus--treated here in the Monascaceae (Ascosphaeriales).

Mycoarachis--initially included in the Pseudeurotiaceae (=Cephalothecaceae here) when originally described (Malloch and Cain, 1970b). It produces two-celled ascospores and, therefore, the genus does not fit into the Plectomycetes as we define them. Probably a member of the Hypocreales (see the discussion under the Cephalothecaceae for details).

Mycogala--according to Hughes (1951) this genus is a synonym of *Orbicula* (*q.v.*). Malloch (1970b) gives a complete list of *Mycogala* species and their synonyms.

Mycorhynchidium--described by Malloch and Cain (1971b) for a cleistothecial fungus with three-spored asci that are enclosed in a membraneous envelope (as in the Ascosphaeraceae) and two-celled ascospores. Malloch and Cain considered *Mycorhynchidium* to be the cleistothecial counterpart of *Mycorhynchus* (Hypocreales)(see Breton and Faurel, 1967; Rogerson, 1970). Some taxa in both genera have three-spored asci. Two-celled ascospores, however, are alien to the Plectomycetes as we define them.

Myrillium--a synonym of *Gymnoascus* according to Kuehn (1959).

Myriococcum--according to Malloch (1970b) the type species, *M. praecox* Fr., has never been shown to have produced ascospores. *Myriococcum albomyces* has since been transferred to *Melanocarpus* (*q.v.*) by von Arx (1975a).

Myxotrichum--treated here in the Gymnoascoideae of the Gymnoascaceae (Onygenales). Kuehn (1959) recognized nine species, whereas Orr *et al.* (1963c) treat seven species in their monograph. Malloch (1979) believes that *Myxotrichum* occupies an isolated position in the Onygenaceae (including the Gymnoascaceae) and he has considered putting it, along with *Toxotrichum*, *Tripedotrichum*, and *Byssoascus* (*q.v.*), in a separate family or treating it as a reduced member of the Pseudeurotiaceae (the Cephalothecaceae here). Species illustrated by Udagawa (1963b).

Nannizzia--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Narasimhella--treated here in the Arachnioideae of the Gymnoascaceae (Onygenales).

Neogymnomyces--treated here as a synonym of *Gymnoascus* as suggested by von Arx (1974b). It was originally described by Orr (1970).

Neosartorya--treated here in the Trichocomaceae (Eurotiales). Species illustrated by Udagawa and Kawasaki (1968; as *Sartorya*).

Neotestudina--the type, *Neotestudina rosatii* Segr. & Dest., is the cause of a mycetoma. Von Arx (1971a) included it in the Testudinaceae. Hawksworth and Booth (1974) transferred the species to *Zopfia* (*q.v.*), but later Hawksworth (1979) recognized *Neotestudina* as a genus of the Testudinaceae. *Pseudophaeotrichum* and *Pseudodelitschia* (*q.v.*) are synonyms.

Neoxenophila--treated here in the Onygenaceae (Onygenaales).

Nephrospora--a synonym of *Microascus* (*q.v.*) according to von Arx (1975c).

Nigrosabulum--treated here in the Cephalothecaceae (Eurotiales).

Onygena--treated here in the Onygenaceae (Onygenales).

Onygenopsis--this genus belongs in the Eurotiales according to Ainsworth (1971). It is reported to be synonymous with *Eurotium diplocystis* Berk. & Br. (Petch, 1912), but Malloch (1970b) says that *E. diplocystis* is not a species of *Eurotium*.

Ophiostoma--treated here in the Ophiostomataceae (Ophiostomatales).

Orbicula--placed in the Eoterfeziaceae by Malloch and Cain (1971b), the Pezizales by von Arx (1974b), and the Pyronemataceae by Jeng and Krug (1976). The genus was monographed by Hughes (1951) and illustrations were provided by Udagawa and Furuya (1972a).

Pectinotrichum--treated in the Gymnoascoideae of the Gymnoascaceae (Onygenales).

Penicilliopsis--treated here in the Trichocomaceae (Eurotiales). Illustrated by Udagawa and Takada (1971).

Perisporium--a member of the Sphaeropsidales according to Cain (1961a).

Peristomium--a synonym of *Microascus* according to von Arx (1975c).

Petalosporus--treated here as a synonym of *Arachniotus* (see von Arx, 1974b, 1977b). The three species described by Ghosh *et al.* (1963) were transferred to *Arachniotus* by von Arx (1977b).

Petriella--treated here in the Microascaceae (Microascales). A synonym of *Microascus* according to Lodha (1978).

Petriellidium--treated here in the Microascaceae (Microascales).

Petromyces--treated here in the Trichocomaceae (Eurotiales).

Peyronellula--according to Stolk (1955) this genus is a synonym of *Emericellopsis*.

Phaeidium--a new name for *Laasiomyces* proposed by Clements and Shear (1931). See Malloch (1970b) for a discussion.

Phaeotrichum--a cleistocarpous loculoascomycete with appendaged ascocarps and two-celled ascospores that Cain (1956b) placed in a new family, the Phaeotrichaceae. Other species described by Malloch and Cain (1972a) and Furuya and Udagawa (1975).

Pisomyxa--a questionable member of the Eurotiales according to Ainsworth (1971).

Pithoascus--treated here in the Pithoascaceae (Microascales).

Plectolitis--a synonym of *Amylocarpus* (*q.v.*) according to Kohlmeyer and Kohlmeyer (1971).

Pleuroascus--treated here in the Onygenaceae (Onygenales).

Plunkettomyces--treated here as a synonym of *Arachniotus*. The type species, *P. littoralis* Orr (1977c), was examined by von Arx (1977b) and transferred to *Arachniotus* as a new species.

Pontoporeia--created for *Sphaeria biturbinata* Dur. & Mont. by Kohlmeyer (1963). Malloch and Cain (1972a) transferred *Pontoporeia* to *Zopfia* (*q.v.*) where it is still retained by Hawksworth and Booth (1974) and Hawksworth (1979).

Preussia--included in the Sporormiaceae (Pleosporales, Luttrell, 1973; Melanommatales, Barr, 1979b). Monographed by Cain (1961a) and shown to have a *Pleospora*-type centrum by Kowalski (1965, 1966).

Preussiella--created by Lodha (1978) for species of *Preussia* with ascospores lacking germ slits. Von Arx (1973b) transferred those species to *Westerdykella* (*q.v.*).

Pseudeurotium--treated here in the Cephalothecaceae (Eurotiales). Species illustrated by Udagawa (1965).

Pseudoarachniotus--treated here as a synonym of *Arachniotus*. Various species have been transferred to *Amauroascus* and *Arachniotus*, or treated as synonyms of species of *Arachniotus* and *Narasimhella* (von Arx, 1971b). Maintained as a valid genus by Orr, Ghosh, and Roy (1977).

Pseudogymnoascus--treated here in the Gymnoascoideae of the Gymnoascaceae (Onygenales).

Pseudophaeotrichum--a synonym of *Neotestudina* (*q.v.*), a genus in the Testudinaceae (von Arx, 1971b; Hawksworth, 1979).

Pteridosperma--a cleistocarpous member of the Melanosporaceae with two species originally escribed in *Microthecium* (Krug and Jeng, 1979). A key to species is provided by Hawksworth and Udagawa (1977, as *Microthecium*).

Pulveria--a cleistocarpous member of the Xylariaceae (Malloch and Rogerson, 1977).

Pycnidiophora--considered a synonym of *Preussia* (*q.v.*) by Cain (1961a) and Malloch (1970b). Von Arx (1974b) and von Arx and Müller (1975), however, consider it a synonym of *Westerdykella* (*q.v.*). Species illustrated by Mukerji and Saxena (1974).

Rechingeriella--a fungus recently transferred to *Zopfia* (Hawksworth and Booth, 1974) but it is now recognized as a distinct genus of the Testudinaceae (Hawksworth, 1979).

Renispora--treated here in the Arachnioideae of the Gymnoascaceae (Onygenales).

Rhexothecium--thought to be related to *Eremomyces* and placed in the Eremomycetaceae by Malloch (1979). Like *Eremomyces bilateralis* Malloch & Cain, *Rhexothecium globosum* Samson & Mouchacca (1975b) has similar ascospores, cleistothecial ontogeny, and manner of spore liberation.

Rhytidospora--a member of the Melanosporaceae whose type, *R. tetraspora* Jeng & Cain (1977) produces cephalothecoid peridia and ascospores which are dark brown, one-celled, produce a wrinkled wall, and two germ pores. Krug and Jeng (1979) add two additional species and provide a key to the species.

Richonia--according to Hawksworth (1979) a monotypic genus of the Testudinaceae. The type species is discussed in detail by Hawksworth and Booth (1974) under *Zopfia variospora* (Boud.) Arnaud.

Rollandina--we follow von Arx (1977b) in treating this genus as a *nomen confusum* since it appears to be based upon two fungi, a stalk that is the stipe of a small mushroom, and the ascocarp of a *Nannizzia* and its *Microsporon* anamorph (Benjamin, 1956a; Apinis, 1970). According to von Arx, *Rollandina sensu* Apinis (1970) is a synonym of *Nannizzia*, but Orr *et al.* (1977), Roy *et al.* (1978), and Ghosh *et al.* (1979) say it is identical to *Pseudoarachniotus hyalinosporus*. Von Arx (1971b, 1974b, 1977b) maintains, however, that *P. hyalinosporus* is identical to *Narasimhella poonensis* and cannot be synonymized with *R. capitata*.

Roumegueriella--a more recent name for *Lilliputia* Boud. according to Malloch and Cain (1972a). Malloch (1970b) placed the genus next to *Heleococcum* (*q.v.*) in the Hypocreaceae in spite of the former producing one-celled ascospores and the latter two-celled ascospores. Light-colored ascocarps, one-celled ascospores, and a *Gliocladium* anamorph suggests a possible relationship of *Roumegueriella* to the Trichocomaceae.

Royella--according to Malloch (1970b) this genus may be a synonym of *Dichotomomyces* (*q.v.*). *Royella* Dwivedi (1960) was published without a Latin diagnosis and, therefore, is a *nomen nudum*.

Sagenoma--treated here in the Trichocomaceae (Eurotiales).

Samarospora--according to Ainsworth (1971) this is a member of the Eurotiales.

Sarophorum--a synonym of *Penicilliopsis* according to Ainsworth (1971) and Malloch and Cain (1972b).

Sartorya--treated here as a synonym of *Neosartorya* (see Malloch and Cain, 1972b, for details).

Saturnomyces--according to Groslags and Swift (1957) this genus is a synonym of *Emericellopsis*.

Sclerocleista--treated here in the Trichocomaceae (Eurotiales).

Shanorella--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Sphaeronaemella--treated here in the Ophiostomataceae (Ophiostomatales).

Spiromastix--treated here in the Arthrodermoideae of the Gymnoascaceae (Onygenales).

Sporophormis--treated here as a synonym of *Warcupiella* (see von Arx, 1974b; Malloch and Cain, 1973b; and Samson, 1979).

Sporormiella--a synonym of *Preussia* (*q.v.*) according to von Arx (1974b).

Subbaromyces--although originally described as a member of the Ophiostomataceae (Hesseltine, 1953), we exclude it from the family and suggest affinities to the Loculoascomycetes.

Syncleistostroma--treated here as a synonym of *Petromy-*

ces. According to Samson (1979), Subramanian (1972) based the genus on an invalidly published anamorphic name. His publication appeared about two months prior to Malloch and Cain's (1972b) description of *Petromyces* (see discussion by Malloch and Cain, 1973b).

Talaromyces--treated here in the Trichocomaceae (Eurotiales). Species illustrated by Udagawa (1963b, 1966).

Testudina--placed in the Pseudeurotiaceae (Cephalothecaceae here) by Malloch and Cain (1970b) because it combined the characteristics found in two other genera included in the family, *Mycoarachis* and *Nigrosabulum*. Von Arx (1971a) placed *Testudina* in his new family Testudinaceae and Hawksworth and Booth (1974) placed the genus in synonymy with *Zopfia* (*q.v.*). More recently, however, Hawksworth (1979) recognized *Testudina* as a valid genus.

Thailandia--originally described as a member of the Gymnoascaceae (Vardhanabhuti, 1959), it was later found to be a species of *Candida* (Orr and Kuehn, 1971).

Thermoascus--treated here under the Onygenaceae (Onygenales).

Thielavia--according to von Arx (1975a) this genus is a cleistothecial member of the Sordariaceae, although many authors place it in the Melanosporaceae (Müller and von Arx, 1973) or the Chaetomiaceae (Malloch and Benny, 1973; Malloch and Cain, 1973a). Malloch and Cain (1973a) treated *Chaetomidium* (*q.v.*) as a synonym of *Thielavia*, but von Arx says that these genera can be separated readily on peridium structure, ascospore morphology, and ascocarp pubescence. Species are illustrated by Udagawa and Takada (1967), Udagawa and Horie (1972a), Horie and Udagawa (1973a, 1973b), and Udagawa and Muroi (1979). New species have been described by Lodha (1974b) and Tansey and Jack (1975). Keys to species are given in the papers of Malloch and Cain (1973a), Beljakova (1974a), and von Arx (1975a)

Thielaviella--according to von Arx (1974b, 1975a) this genus is a synonym of *Thielavia*.

Toxotrichum--treated here as a synonym of *Myxotrichum* (*q.v.*). The type is based upon *Myxotrichum cancellatum* Phil. (von Arx, 1974b).

Trichocoma--treated here in the Trichocomaceae (Eurotiales).

Trichodelitschia--according to Malloch (1970b), *Trichodelitschia* (Lundqvist, 1964) is the ostiolate counterpart of *Phaeotrichum*. Von Arx and Müller (1975) state that it is the ostiolate relative of both *Phaeotrichum* and *Neotestudina*, and Barr (1979b) includes all three genera in the Phaeotrichaceae.

Trichomonascus--a monotypic genus, *T. mycophagus* Jackson (1947), was found as a parasite on *Corticium confluens* Fr. and was placed by him in the Aspergillaceae (Trichocomaceae here). There is no family, however, in the Plectomycetes (*sensu* Benny and Kimbrough) in which this fungus can be placed. Based upon original descriptions and illustrations (Jackson, 1947), the mechanism of fertilization resembles that found in *Lasiobolus monascus* Kimbr. (Kimbrough and Benny, 1978) but other features are reminiscent of the Monascaceae, *i.e.*, a reduced vegetative phase with a cell developing into the ascocarp and the presence of a trichogyne. Fresh material will be needed to determine if asci are in fact produced, and if they are formed, if *Trichomonascus* is related to any other known taxon.

Trichoscytale--or *Trichoskytale*, treated here as a synonym of *Trichocoma* (see Malloch and Cain, 1972b).

Tripterospora--a cleistothecial counterpart of *Podospora* according to Müller and von Arx (1973). *Tripterospora* Cain (1956c) is maintained as a valid genus by Lundqvist (1969), Malloch (1970b), and Malloch and Cain (1971d), but Müller and von Arx (1975a) later placed it in synonymy with *Zopfiella* (*q.v.*).

Tripterosporella--described by Subramanian and Lodha (1968) and considered as one of the cleistothecial Sordariaceae (Malloch and Cain, 1971b).

Tripedotrichum--described from a collection of herbarium material that also contains *Myxotrichum chartarium* (Nees) Kunze (Orr and Kuehn, 1964b). We are following von Arx (1977b) in considering *Tripedotrichum* to be a synonym of *Gymnoascus*.

Ulospora--according to Hawksworth (1979) this is a member of the Testudinaceae. Incorrect citation of the basionym and improper combinations make *Ulospora* an invalid genus (see Hawksworth and Booth, 1974; von Arx and Müller, 1975; and Hawksworth, 1979).

Uncinocarpus--treated here as a synonym of *Gymnoascus*. *Uncinocarpus* Sigler & Orr (Sigler and Carmichael, 1976) was described for a gymnoascaceous fungus with a *Chrysosporium* anamorph. Von Arx (1977b) believes that this fungus is similar to *Gymnoascus uncinatus* Eidam.

Veronaia--a member of the Eurotiales with unknown affinities according to Ainsworth (1971).

Waldemaria--treated here as a synonym of *Arachniotus*. The type of *Waldemaria* is considered to be identical to *Arachniotus dankaliensis* (Cast.) van Beyma (von Arx, 1971b; Orr and Kuehn, 1971). The latter authors provide an extensive discussion of *Waldemaria*.

Warcupia--a soil fungus that Paden and Cameron (1972) say shows some relationship to *Cleistothelebolus*, *Lasiobolidium*, and *Orbicula* (*q.v.*), all possible members of the Eoterfeziaceae.

Warcupiella--treated here in the Trichocomaceae (Eurotiales).

Westerdykella--a cleistothecial member of the Sporormiaceae described by Stolk (1955) but treated as a synonym of *Preussia* (*q.v.*) by Cain (1961a). Von Arx (1973b, 1974b) and von Arx and Müller (1975) consider it to be a valid genus and von Arx (1973b) has transferred several species into *Westerdykella*.

Xanthothecium--Treated here in the Onygenaceae (Onygenales) Illustrations provided by Udagawa (1963b, as *Anixiopsis*).

Xeromyces--treated here in the Monascaceae (Ascosphaerales).

Xylogone--treated here in the Onygenaceae (Onygenales).

Xynophilia--treated here in the Onygenaceae (Onygenales).

Zopfia--a member of the loculoascomycete family Testudinaceae that has been monographed by Hawksworth and Booth (1974). In the broad sense they included in the genus cleistothecial taxa with cephalothecoid peridia and two-celled ascospores. The following genera were synonymized with *Zopfia*: *Celtidia*, *Lepidosphaeria*, *Marchaliella*, *Neotestudina*, *Pontoporeia*, *Pseudophaeotrichum*, *Rechingeriella*, *Richonia*, and *Testudina* (*q.v.*). In a later examination of *Zopfia*, Hawksworth (1979) included only three species, *Z. albizia* Farr, *Z. biturbinata* (Dur. & Mont.) Malloch & Cain, and *Z. rhizophila* Rabenh., in the genus. Only *Pontoporeia* is still considered to be a synonym of *Zopfia*.

Zopfiella--a member of the Sordariaceae, considered to be the cleistothecial counterpart of *Triangularia* (Malloch and Cain, 1971d). These authors provide a key to species and Furuya and Udagawa (1972, 1973, 1975), Udagawa and Furuya, 1972b), Udagawa and Horie (1974, 1975), and Udagawa and Takada (1974) provide illustrations.

Zopfiofoveola--a monotypic genus proposed by Hawksworth (1979), based upon *Zopfia punctata* Hawks. & Booth, and placed in the Testudinaceae. Von Arx and Müller (1975), however, placed *Z. punctata* in *Lepidosphaera*.

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A CLASSIFICATION OF PLECTOMYCETES AND OTHER CLEISTOTHECIAL ASCOMYCETES

(?=questionable member of taxon)

- PLECTOMYCETES
  - EUROTIALES
    - Cephalothecaceae
      - *Aporothielavia*
      - *Cephalotheca*
        - =*Aposphaeropsis*
        - ?*Carothecis*
        - =*Crepinula*
      - *Connersia*
      - *Cryptendoxyla*
      - *Emericellopsis*
        - ?*Capsulotheca*
        - =*Diplostephanus*
        - =*Peyronellula*
        - =*Saturnomyces*
      - *Fragosphaeria*
      - *Hapsidospora*
      - *Leucosphaera*
      - *Nigrosabulum*
      - *Pseudeurotium*
        - =*Levispora*
    - Trichocomaceae
      - =Eurotiaceae
      - =Trichocomataceae
      - *Aphanoascus*
      - *Byssochlamys*
      - *Chaetosartorya*
        - =*Harpezomyces*
      - *Dactylomyces*
      - *Dichlaena*
      - *Edyuilla*
        - =*Gymnoeurotium*
      - *Emericella*
        - =*Cleistosoma*
        - =*Inzengaea*
      - *Eupenicillium*
        - =*Carpenteles*
      - *Eurotium*
      - *Fennellia*
      - *Hamigera*
      - *Hemicarpenteles*
      - *Hemisartorya*
        - =*Sartorya*
      - *Penicilliopsis*
        - =*Sarophorum*
      - *Petromyces*
        - =*Syncleistostroma*
      - *Roumegueriella*
        - =*Lilliputia*
      - *Sagenoma*
      - *Sclerocleista*
      - *Talaromyces*
      - *Trichocoma*
        - =*Trichoskytale*
      - *Warcupiella*
        - =*Sporophormis*
  - ASCOSPHAERIALES
    - Ascosphaeriaceae
      - =Pericystaceae
      - =Synascomycetaceae
      - *Arrhenosphaera*
      - *Ascosphaera*
        - =*Pericystis*
      - *Bettsia*
    - Monascaceae
      - *Ascorhiza*
      - *Leiothecium*
      - *Monascus*
        - =*Backusia*
      - *Xeromyces*
  - OPHIOSTOMATALES
    - Ophiostomataceae
      - *Ceratocystis*
      - *Ceratocystopsis*
      - *Ophiostoma*
        - =*Europhium*
      - *Sphaeronaemella*
  - MICROASCALES
    - Chadefaudiellaceae
      - *Chadefaudiella*
    - Microascaceae
      - =Lophotrichaceae
      - *Enterocarpus*
      - *Kernia*
        - =*Magnusia*
      - *Lophotrichus*
      - *Microascus*
        - =*Fairmania*
        - =*Nephrospora*
        - =*Peristomium*
      - *Petriella*
      - *Petriellidium*
        - =*Allescheria*
        - =*Eurotiella*
        - =*Eurotiopsis*
    - Pithoascaceae
      - *Faurelina*
      - *Pithoascus*
  - ONYGENALES
    - Dendrosphaeraceae
      - *Dendrosphaera*
    - Gymnoascaceae
      - Arachnioideae
        - *Amauroascus*
        - *Arachniotus*
          - =*Disarticulatus*
          - =*Petalosporus*
          - =*Plunkettomyces*
          - =*Pseudoarachniotus*
          - =*Rollandina*
          - =*Waldemaria*
        - *Arachnotheca*
          - =*Kuehniella*
        - *Byssoascus*
        - *Narasimhella*
      - Arthrodermoideae
        - *Ajellomyces*
          - =*Emmonsiella*
        - *Apinisia*
        - *Arthroderma*
        - *Nannizzia*
        - *Renispora*
        - *Shanorella*
        - *Spiromastix*
      - Gymnoascoideae
        - *Auxarthron*
        - *Ctenomyces*
        - *Gymnoascus*
          - =*Gymnascella*
          - =*Gymnoascoideus*
          - =*Macronodus*
          - =*Neogymnomyces*
          - =*Tripedotrichum*
          - =*Uncinocarpus*
        - *Myxotrichum*
          - =*Actinospira*
          - =*Eidamella*
          - =*Toxotrichum*
        - *Pectinotrichum*
        - *Pseudogymnoascus*
    - Onygenaceae
      - =Thermoascaceae
      - *Anixiopsis*
      - *Arachnomyces*
      - *Ascocalvatia*
      - *Dichotomomyces*
        - =*Royella*
      - *Keratinophyton*

- *Leucothecium*
- *Neoxenophila*
- *Onygena*
- *Pleuroascus*
- *Thermoascus*
- *Xanthothecium*
- *Xylogone*
- *Xynophila*

PYRENOMYCETES

CHAETOMIALES

- Chaetomiaceae
  - *Chaetomidium*

HYPOCREALES

- Hypocreaceae
  - *Amylocarpus*
    - =*Plectolitus*
  - *Battarrina*
  - *Heleococcum*
  - *Mycoarachis*
  - *Mycorhynchidium*

SORDARIALES

- Coniochaetaceae
  - *Coniochaetidium*
  - *Ephemeroascus*
  - *Germslitospora*
- ?Eoterfeziaceae (see Discomycetes)
- Halosphaeriaceae
  - *Chadefaudia*
  - ?*Eiona*
- Melanosporaceae
  - *Microthecium*
  - *Pteridosperma*
  - *Rhytidospora*
- Sordariaceae
  - *Anixiella*
  - *Apodus*
  - *Bombardia*
  - *Copromyces*
  - *Corynascus*
  - *Corynascella*
  - *Diplogelasinospora*
  - *Echinopodospora*
  - *Eosphaeria*
  - ?*Guilliermondia*
  - ?*Melanocarpus*
    - =*Myriococcum*
  - *Thielavia*
    - =*Boothiella*
    - =*Thielaviella*
  - *Triptosporella*
  - *Zopfiella*
    - =*Cleistobombardia*
- Xylariaceae
  - *Pulveria*

DISCOMYCETES

HELOTIALES

- Hemiphacidiaceae
  - =Amorphothecaceae
  - *Amorphotheca*

PEZIZALES

- ?Eoterfeziaceae
  - *Cleistothelebolus*
  - *Eoterfezia*
  - *Lasiobolidium*
  - *Microeurotium*
  - *Orbicula*
    - =*Didymium*
    - =*Mycogala*
  - *Warcupia*
- Pyronemataceae
  - *Eleutherascus*
    - =*Hemiascosporium*

ELAPHOMYCETALES

- Elaphomycetaceae
  - *Elaphomyces*
    - =*Ascoscleroderma*

LOCULOASCOMYCETES

DOTHIDIALES

- ?Testudinaceae
  - *Celtidia*
  - *Lepidosphaeria*
  - *Neotestudina*
    - =*Pseudophaeotrichum*
  - *Richingeriella*
  - *Richonia*
  - *Testudina*
    - =*Marchaliella*
  - *Ulospora*
  - *Zopfia*
    - =*Pontoporeia*
  - *Zopfiofoveola*

PLEOSPORALES

- Phaeotrichaceae
  - ?*Neotestudina* (see Testudinaceae)
  - *Phaeotrichum*
  - *Trichodelitschia*
- Sporormiaceae
  - *Pruessia*
    - =*Fleishhakia*
    - =*Honoratia*
    - =*Sporormiella*
  - *Westerdykella*
    - =*Puressiella*
    - =*Pycnidiophora*
- ?Eremomycetaceae
  - *Eremomyces*
  - *Rhexothecium*

?LOCULOASCOMYCETES

- *Ceratocarpis*
- *Cleistotheca*
- *Dexteria*
- *Leuconeurospora*
- *Subbaromyces*

GENERA OF UNCERTAIN AFFINITIES

- *Albertinella*
- *Argynna*
- *Batistia*
- ?*Capsulotheca*
- *Chaetotheca*
- *Eremodothis*
- *Eurotiopsis* Karst.
- *Guilliermondia*
- *Gymnoascopsis*
- *Hexagonella*
- *Laasiomyces*
  - =*Phaeidium*
- *Pisomyxa*
- *Samarospora*
- *Trichomonascus*
- *Veronaia*

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NEW TAXA OF RUSSULA FROM THE LESSER ANTILLES

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During the course of preparatory studies on the genus *Russula* Pers. ex S.F. Gray for forthcoming accounts due to appear in 'Flora Neotropica' and 'Agaric Flora of the Lesser Antilles, it became apparent that a number of new species needed to be described and an infrageneric revision is required to take account of the tropical species. Latin diagnoses of these new taxa are given here and more detailed, illustrated accounts will appear at a later stage.

Section **Pellicularieae** Heim in Prodr. Fl. Mycol. Madag. 1: 121 (1938) emend. Singer

Basidiocarp fragile, small to medium. Pileus with a membranous context and an acute margin which is plicate-striate from an early stage. Lamellulae present, numerous. Veil present or absent. Context soft, soon decaying. Spore print white to cartridge buff. Spores almost orthotropic, with a small, amyloid suprahilar plage. Pileipellis not epithelial. Tropical, often non-mycorrhizal or facultatively ectomycorrhizal. Type species: *R. annulata* Heim.

Russula hygrophytica Pegler, sp. nov.

Pileus 4.5–5.5 cm latus, convexus vel in centro tantum depressus, ad discum fuscus, ad marginem pallide griseo-brunneus, viscidus, sulcato-striatus, pectinato-fissus. Lamellae adnexae, albidae, simplices, moderate confertae, intervenosae, interdum furcatae. Stipes 4–5 × 0.5–1 cm, cylindricus, cavus, albidus, glaber. Caro membranacea, albida, immutabilis; odor nullus, sapor mitis vel tarde subacris. Sporae 6.5–9 × 6–8.5 (7.6 ± 0.5 × 7.3 ± 0.5) µm (excl. orn.), Q = 1.05, subglobosae, melleo-hylinae, valde amyloideae, ornamentatione cristato-reticulato praeditae. Basidia 34–47 × 8–11 µm, clavato-ventricosa, 2– vel 4-sporigera. Cheilocystidia 35–55 × 7–14 µm, clavato-mucronata, hyalina, tenuitunicata. Macrocystidia copiosa, 45–70 × 8–11 µm, clavata vel mucronata, intus contento in sulphovanillina caerulescente repleta. Trama hymenophoralis intermixta. Cuticula e stratis tribus composita. Epicutis 35–80 µm lata, ex hyphis filamentosis et dermatocystidiis numerosis efformata. Cutis 75–200 µm lata, ex hyphis dispersis, gelatinosa. Hypodermium 20–35 µm latum, ex hyphis brunneis, agglutinatis efformatum. Typus: Martinica, Plateau Perdrix, in silvis pluvialibus, 23 Aug. 1976, Fiard 506 F, K.

Closely related to the common and widespread, neotropical species, *R. puiggarii* (Speg.) Singer, but differs macroscopically in the more crowded lamellae, a more strongly tuberculate pileal margin, and occurring at a higher altitude in a hygrophytic forest rather than in a mesophytic locality. Microscopically the spores are smaller, the pileipellis has a more strongly developed gelatinized layer with numerous dermatocystidia, and the macrocystidia differ in shape.

Section **Metachromaticae** Singer, sect. nov.

Pileus carnosus, pigmenti destitutus. Lamellae confertae, cum ordinibus lamellularum intermixtae. Sporae in cumulo pallidae; macula suprahilari amyloidea. Macrocystidia crassitunicata, metachromatica in azureo cresylico. Epicutis pilei ex hyphis et dermatocystidiis composita. Species typicum: *R. metachromatica* Singer.

Section **Delicinae** (Bataille) Melzer & Zvara, Ceská Holubinky: 53 (1927) emend. Singer

Habit of Lactarius. Pileus with an acute margin. Lamellae subdecurrent, with few to numerous lamellulae but not regularly arranged. Context hard and firm, not brittle, scarcely discolouring on exposure. Spore print white to cream-colour. Spores with an amyloid suprahilar plage. Cystidia neither metuloidal nor metachromatic with Cresyl blue. Obligatorily ectomycorrhizal. Type species: *R. delica* Fr.

Russula littoralis Pegler, sp. nov.

Pileus 4–6.6 cm latus, carnosus, e hemisphaerico convexus vel leviter depressus, pallide cremeus vel eburneus, ad marginem lilacinus, glaber, humidus, non striatus. Lamellae adnato-decurrentes, pallide cremeae, ventricosae, saepe furcatae, moderate confertae, lamellulis paucis intermixtae. Stipes 2.5–5 × 1–1.7 cm, cylindricus, solidus, albidus, glaber, siccus, rugulosus. Caro usque ad 6 mm crassa, firma, albida, immutabilis; sapor mitis. Sporae 6.5–8 × 5.5–6.5 (7.5 ± 0.4 × 6 ± 0.3) µm (excl. orn.), Q = 1.22, subglobosae vel late ovoideae, hyalinae, ornamentatione verrucosa hemisphaerica amyloidea, verrucis 0.5 µm altis, vestitae. Basidia 35–45 × 8–10 µm, clavata, 2– vel 4-sporigera. Macrocystidia numerosa, 55–75 × 7–10 µm, lanceolata-fusiformia, ad apicem constricta vel mucronata, tenuitunicata, hyalina. Trama hymenophoralis intermixta, sphaerocystidibus numerosis praedita. Epicutis pilei ex hyphis pallisadice dispositis efformata. Typus: Martinica, Grand Macabou, in solo arenario, 9 Dec. 1976, Fiard 139 D, K.

Differs from *R. austrodelica* Singer, *R. delica* Fr. and *R. fuegiana* Singer in the smaller spores, lilaceous tints on the pileal margin, and the sea-shore association with the Seagrape, *Coccoloba uvifera* L.

Section **Russula**

Basidiocarp fragile to robust, small to large. Pileus with acute or obtuse margin, often brightly coloured, sometimes brown or white; margin inrolled only in very early states. Lamellae white, cream, ochre or yellow; lamellulae absent or very few. Spore print white to deep ochraceous. Spores with suprahilar plage usually amyloid. Dermatocystidia often abundant, fusoid or clavate. Obligatorily ectomycorrhizal. Type species: *R. emetica* (Huds. ex Fr.) Fr.

Subsection **Emeticinae** Melzer & Zvara, Ceská Holubinky: 105 (1927).

Pileus red, purple, violet or orange, rarely green or yellow. Taste acrid or at least bitter, very rarely mild. Spore print white or cream. Dermatocystidia always conspicuous in the pileiellis.

Russula martinica Pegler, sp. nov.

Pileus 4.5–8 cm latus, convexo-expansus, depressus, coccineus, disco lutescens, siccus, subtiliter velutinus, ad marginem sulcatus. Lamellae adnatae, ochroleucae, moderatim confertae, lamellulis intermixtae. Stipes 4–5 × 1–2 cm, robustus, cylindricus, fistulosus dein cavus, albidus, glaber, rugosus. Caro 3–5 mm crassa, albida, immutabilis; odor inconspicuus; sapor leviter acris. Sporae in cumulo cremeo-bubalinae, 7–8.5 × 5.5–7.5 (7.7 ± 0.4 × 6.6 ± 0.4) µm (excl. orn.), Q = 1.16, subglobosae vel obovoideae, hyalinae, valde amyloideae, ornamentatione verrucosa, verrucis 0.5 µm altis numerosis obtectae macula suprahilari amyloidea. Basidia 25–30 × 7–9 µm, clavata, 4-sporigera. Acies lamellarum heteromorphosa; pseudocystidia copiosa, 50–75 × 5–10 µm, ventricoso-fusiformia vel acuminata, hyalina, tenuitunicata. Trama hymenophoralis irregularis, intermixta. Epicutis pilei ex elementis piliformibus plus minusve erectis, tenuitunicatis et dermatocystidiis composita. Typus: Martinica, Trace de Tombeau Caraibe, 1 Nov. 1975, Fiard 662 A, K.

Subsection **Heterophyllae** Fr., Monogr. Hymen. Suec. 2: 193 (1863).

Pileus typically grey, greyish olive, greyish blue, violaceous, citrine yellow or green, never red or orange; surface pruinose to finely tomentose. Taste mild or slightly bitter. Spore print white to cream. Epicutis lacking fuchsinophile hyphae.

Russula diversicolor Pegler, sp. nov.

Pileus 3.4–4 cm latus, convexus vel plano-convexus, depressus, versicolor, ad discum avellaneous, ad marginem alutaceus, olivaceo vel roseo intermixtus, subviscidus mox siccus, glaber, margine acuto, striato-pectinato praeditus. Lamellae adnatae, pallide cremeae, saepe furcatae, moderate confertae, lamellulis rarissimis intermixtae. Stipes 2–3 cm × 6–8 mm, cylindricus, cavus, albidus vel pallide griseus, glaber, laevis. Caro tenuissima, albida, immutabilis; odor distinctus; sapor mitis. Sporae 8–9.5 × 6.5–8.5 (8.8 ± 0.4 × 7.6 ± 0.4) µm. (excl. orn.), Q = 1.16, subglobosae vel obovoideae, hyaline, valde amyloideae, ornamentatione verrucosa, verrucis 0.5 µm altis numerosis obtectae; plaga suprahilari inamyloidea. Basidia 33–40 × 11–13 µm, inflato-clavata, 4-sporigera. Acies lamellarum sterilis. Pseudocystidia 55–80 × 6–11 µm, ventricoso-lageniformia, hyalina, tenuitunicata. Trama hymenophoralis irregularis, intermixta. Epicutis pilei ex hyphis trichodermialibus composita. Typus: Martinica, Anse à Voiles, 15 Oct. 1975, Fiard 628 A, K.

Russula venezueliana Singer is extremely similar to this species but has a more uniformly dark yellowish brown pileus, a greyish brown stipe, and some reticulation of the spore ornamentation. Typically in many species of the Heterophyllae the suprahilar plage remains inamyloid.

Russula cremeolilacina Pegler, sp. nov.

Pileus 4–5.3 cm latus, e convexo-expansus, depressus, ad disum cremeus vel pallide lilacinus, subviscidus, subrugosus. Lamellae adnatae, albidae vel cremeae, furcatae, moderate confertae. Stipes 3–6.5 × 1–1.2 cm, cylindricus, fistulosus, candidus, glaber, rugosus. Caro firma, candida, immutabilis; odor nullus; sapor mitis. Sporae 6.5–8.5 × 5.5–7(7.5 ± 0.4 × 6 ± 0.5) µm (excl. orn.), Q = 1.26, subglobosae vel obovoideae, hyalinae, amyloideae, ornamentatione verrucosa et subreticulata, verrucis 0.5 µm altis vestita; macula suprahilari amyloidea. Basidia 28–35 × 11–12 µm, inflato-clavata, 4-sporigera. Acies lamellarum heteromorphosa. Macrocystidia dispersa, 60–110 × 7–10 µm, mucronato-fusiformia, hyalina, tenuitunicata, contento in sulphovanillina atro caerulescentia repleta. Trama hymenophoralis irregularis, intermixta. Epicutis pilei ex hyphis suberectis et dermatocystidiis composita. Typus: Martinica, Caravelle, in silvis xero-mephyticis, 4 Sept. 1976, Fiard 772 A, K.

Closely related to the North temperate species, *R. cyanoxantha* (Schaeff. ex Secr.) Fr. but differing in the smaller stature and brighter pigmentation.

Subsection **Foetentinae** Melzer & Zvara, Ceská Holubinky: 98 (1927).

Pileus generally dull, yellow, brown or grey, very rarely green; pileal margin frequently plicate-tuberculate. Taste mostly acrid or bitter sometimes mild; odour often distinctive, nauseous, foetid or of bitter almonds. Spore print white, cream or pale ochre.

Russula marronina Pegler, sp. nov.

Pileus 2–5 cm latus, fragilis, plano-convexus, depressus, pallide brunneus, ad discum marroninus, glaber, in humido viscidus dein siccus, ad marginem lento sulcato-striatus. Lamellae adnatae, cremeae, saepe frucatae, moderate confertae. Stipes 2.5–4 cm × 5–9 mm, cylindricus vel ad basim attenuatus, lacunosus dein cavus, albidus, glaber, laevis. Caro tenuissima, albida, immutabilis; odor amygdalinus amarus revocans; sapor lente acerrimus. Sporae in cumulo pallide cremeae, 7.5–9 × 6.5–8(8.5 ± 0.4 × 7.2 ± 0.4) µm, Q = 1.18, subglobosae, hyalinae, ornamentatione subreticulata amyloidea, verrucis crassis 0.5–1 µm altis praeditae. Basidia 30–40 × 9–11 µm, clavata, 4-sporigera. Acies lamellarum heteromorphosa. Cheilocystidia macrocystidioidiis similia, 45–65 × 8–11 µm, fusiformia, hyalina vel lutea, contento in sulphovanillina caerulescentia repleta. Pleurocystidia nulla. Trama hymenophoralis irregularis, intermixta. Epicutis pilei gelatinosa, ex hyphis septatis filiformibus et dermatocystidiis dispersis composita. Typus: Martinica, Trinité, 3 Nov. 1975, Fiard 661 K.

Close to the *R. sororia*-group of North temperate regions, especially to *R. amoenolens* Romagn. but differing in the reddish brown pileus, white stipe and subglobose spores with a coarsely verrucose ornamentation.

Russula mephitica Pegler, sp. nov.

Pileus 2.7–5.6 cm latus, moderate carnosus, convexus mox depressus, pallide ochraceus vel pallide cinnamomeo-bubalinus, in statu humido glutinosus, glaber; ad marginem pectinatus. Lamellae adnatae, ochraceo-cremeae, saepe furcatae, moderate confertae, aequilongae. Stipes 2.5–4.5 cm × 8–12 mm, cylindricus, cavus, albidus, glaber. Caro tenuis, albida, immutabilis; odor forte odore *R. foetentis* similis; sapor mitis. Sporae 7.5–9 × 6–7.5(8 ± 0.4 × 6.7 ± 0.4) µm (excl. orn.), Q = 1.20, obovoideae vel late ellipsoideae, hyalinae, ornamentatione verrucosa amyloidea, verrucis grossis et connectivis raris obtectae. Basidia 28–34 × 9–10 µm, inflato-clavata, 4-sporigera. Acies lamellarum heteromorphosa. Macrocystidia numerosa, 40–75 × 8–12 µm, ventricoso-fusiformia, tenuitunicata, ad apicem in sulphovanillina caerulescentia. Trama hymenophoralis irregularis, intermixta. Epicutis pilei gelatinosa, ex hyphis filiformibus et dermatocystidiis composita. Typus: Martinica, Morne Chopotte, in silvis mesophyticis, 23 Dec. 1975, Fiard 678 K.

Similar to *R. foetens* (Pers. ex Fr.) Fr. but much smaller and more delicate. The species might be compared to *R. foetens* var. *minor* Singer or to *R. foetentula* Peck.

Russula ochrostraminea Pegler, sp. nov.

Pileus 3–5 cm latus, moderate carnosus, convexo-expansus, depressus, postremo perforatus, pallide ochraceo-bubalinus vel ochraceo-aurantiacus, valde viscidus, ad marginem plicato-tuberculatus. Lamellae adnatae, cremeae vel eburneae, intervenosae, moderate confertae. Stipes 2–3 cm × 8–10 mm, cylindricus, cavus, albidus vel pallide griseus, laevis, glaber. Caro ravida, immutabilis; odor debilis; sapor mitis. Sporae 7–9 × 6–8(8 ± 0.4 × 7 ± 0.5) µm (excl. orn.), Q = 1.15, subglobosae vel obovoideae, hyalinae, ornamentatione reticulata, verrucis 0.5–0.7 µm altis grossis confertis vestitae; macula suprahilari amyloidea. Basidia 35–38 × 10–12 µm, clavata, 4-sporigera. Acies lamellarum heteromorphosa. Macrocystidia dispersa, 35–65 × 7–12 µm, cylindrico-fusiformia, acuminata, subhyalina, in sulphovanillina pallide caerulescentia. Trama hymenophoralis irregularis, intermixta. Epicutis pilei ex hyphis intermixtis gelatinosis et dermatocystidiis efformata. Typus: Martinica, Rivière-Pilote, 30 Oct. 1975, Fiard 656 K.

The species occurs after heavy rains in otherwise dry situations. It belongs in the Subsection *Foetentinae* but is atypical in lacking a distinctive odour and the taste is mild. It might be compared to *R. consobrinoides* Heim, from Madagascar, but lacks the foetid odour of that species.

Subsection **Decolorantinae** Melzer & Zvara, Ceská Holubinky: 61 (1927).

Basidiocarp robust. Pileus cinnabar red, orange or yellow, rarely white, never brown or green. Taste mild. Spore print ochre or yellow. Dermatocystidia present in the pileipellis.

Russula matoubensis Pegler, sp. nov.

Pileus 6–10 cm latus, carnosus, e convexo applanatus, depressus, aurantiacus, subviscidus, glaber vel ad marginem areolatus, non-striatus. Lamellae adnatae, pallide cremeae, angustatae, saepe furcatae, confertissimae, cum ordinibus lamellularum intermixtae. Stipes 4–4.5 × 1.5–2 cm, ad basim attenuatus, e pileo concolor, siccus, glaber, laevis. Caro crassa, albida dein cinerascens; odor nullus; sapor mitis. Sporae 8.5–10 × 7.5–9(9.6 ± 0.6 × 8.3 ± 0.4) µm (excl. orn.), Q = 1.15, subglobosae vel obovoideae, hyalinae, amyloideae, ornamentatione reticulata, 0.5-ium alta; macula suprahilari amyloidea. Basidia 37–43 × 9–12 µm, clavata vel ventricosa, 2– vel 4-sporigera. Macrocystidia 60–75 × 5–9 µm, lanceolato-fusiformia, hyalina, tenuitunicata, intus in sulphovanillina caerulescentia. Trama hymenophoralis intermixta, hyalina. Epicutis pilei ex hyphis filamentosis et dermatocystidiis aurantiacis efformata. Typus: Guadalupa Insula, Basse Terre, Trace Victor Hughes, in solo nudo, 16 Aug. 1975, Fiard 550 A, K.

Similar to *R. decolorans* (Fr.) Fr. but the stipe is orange and the context discolours only to grey rather than blackening.

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TERMITARIOPSIS CAVERNOSA, GEN. AND SP. NOV., A SPORODOCHIAL FUNGUS ECTOPARASITIC ON ANTS

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SUMMARY

Four collections of army ants (*Neivamyrmex*) were infected with a sporodochial fungus with similarities to *Termitaria* Thaxter and *Mattirolella* Colla known only from species of termites and *Muiogone* Thaxter known from dipterans. This fungus is described here as *Termitariopsis cavernosa*, gen. et sp. nov. Morphological similarity of complex structures in these genera of entomophilous fungi and the proximity in nature of the ant and termite hosts are taken as evidence of possible phylogenetic relationship.

Four collections of army ants (*Neivamyrmex*) referred to us contained thalli of an undescribed fungus:

Neivamyrmex opacithorax Emery. Kansas; Riley Co., Manhattan, 26 V 1964, C. W. Rettenmeyer 3018, Colony E-387, 6 specimens. Kansas: Riley Co., Manhattan, Kansas State Hill, 7 VIII 1962, R. D. Akre, Colony E-278, 20 specimens. Kansas: Manhattan, C. W. Rettenmeyer 3593, Colony E-513. 6 specimens. *Neivamyrmex pilosus* (F. Smith). Panama: Canal Zone, Barro Colorado Island, 15 II 1961, E. O. Willis. 1 specimen.

Some infected portions of the insect integument were removed with the aid of a dissecting microscope (X40) and mounted in a glycerol solution containing acid fuschin (Benjamin, 1971) or crystal violet. Other infected portions were dehydrated through an alcoholic series to acetone and embedded in low viscosity plastic (Spurr, 1962) and sectioned with an ultramicrotome or were frozen and sectioned with a cryostat. For scanning electron microscopy infected portions of the insect were air dried, gold coated with a Polaron sputter coater, and examined in an AMR-1000 A microscope.

Termitariopsis Blackwell, Samson, et Kimbrough, gen. nov.
Entomophilous; thallus principalis crustosus, stromaticus; haustoria e fusco crassitunicato cellularum strato orientio; integer thallus principalis in exciplo sterili sporodochium maturans; cellululae excipuli cavitatem solitariam includentes; pseudoparenchymatum subhymenium hymenium phialidum, quod conida in ordine basipetalo apicaliter abscindit, emittens; sporodochi cavitas macroconidiis et microconidiis. Typus: *Termitaria cavernosa* Blackwell, Samson, et Kimbrough.

Entomophilous; primary thallus crustose, stromati; haustoria arising from a dark, thick-walled layer of cells; entire primary thallus maturing into a sporodochium with some excipular cells producing phialoconidium-like cells; pseudoparenchymatous subhymenium giving rise to hymenial layer of septate filaments; some of these filaments producing multicellular, appendaged macroconida; microconidia produced at the appendage tips.

Termitariopsis cavernosa Blackwell, Samson, et Kimbrough, sp. nov.
Entomophilous; thallus principalis crustosus, stromaticus, pluribus cellulis crassus; maturans in varianti forma sporodochium secundum positionem in insecto hospite, sed plerumque elongatus; basale stratum omnino crassitunicatis fuscis cellulae matricales haustorii, 5 x 10 μm; excipulum fuscis elongatis crassitunicatis sterilibus cellulis; interna sporodochi cavitas continens sphaericas ad elongatas crassitunicatas pseudoparenchymatas massas, facile separatas a subhymenio; phialidas, 2-3 μm in strato e subhymenio orientes, conidia a locis conidiogeneribus intra elongatas collarettas abscindentes, altitudinem excipuli attingentes, intra collarettas saltem quinque conidia; conidia hyalina cylindrica aut marginibus truncatis, 1.5 x 2.5-4 μm; caviats sporodochi interna continens hymenium filamentis septalibus minoribus dimidio quam altitudine filamentorum excipuli; emmittertia multicellularia appendiculata macroconidia, 20-30 x 40-60 μm; appendices macroconididiarum emmittentes spherica microconidia, 2 μm diametro.

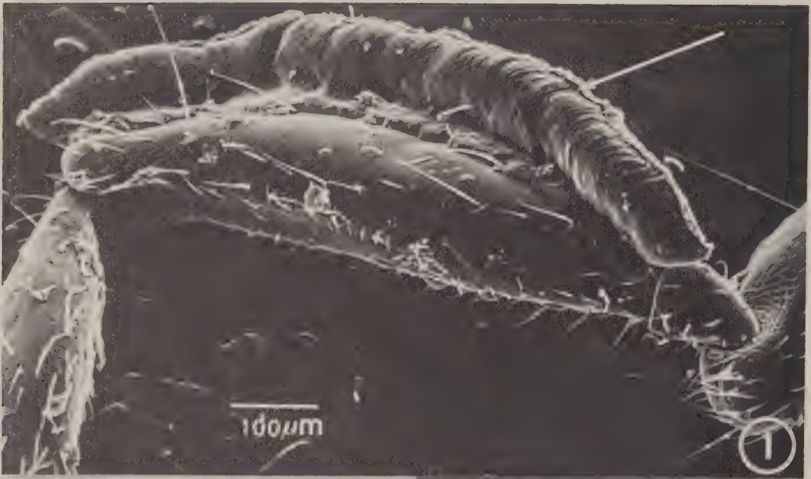
Holotypus in *Neivamyrmex opacithorax* Emery, 26 V 1964.
C. W. Rettenmeyer 3018. Kansas: Riley Co., Manhattan. Holotype deposited in BPI; isotypes in CBS (Baarn), Farlow.
Known from Kansas and Panama.

Entomophilous (Figs. 1,2); primary thallus crustose, stromatic, several cells thick; maturing to a sporodochium of varying shape depending upon the site of infection on the insect host, but usually elongated (Figs. 1,2); basal layer entirely of thick-walled, dark haustorial mother cells, 5x10 µm (Figs. 3,4), which give rise to haustoria on the lower side (Fig. 5) end with a hyaline pseudoparenchymatous subhymenium above (Fig. 4); excipulum of dark, elongated, thick-walled cells, 100 µm x 3 µm (Figs. 2,6,7), some of which contain phialoconidium-like cells, 2 x 4 µm (Figs. 6,7); internal sporodochial cavity containing hymenium of septate filaments less than half the height of the excipular filaments (Fig. 6); giving rise to multicellular, appendaged macroconidia, 20-30x40-60 µm (Figs. 6,8); macroconidial appendages giving rise to spherical microconidia, 2 µm diam (Fig. 8).

The Panamanian specimens differ from the Kansan specimens in that the sporodochial cavity is packed with macroconida and may represent a later stage of maturity.

The large multicellular, appendaged macroconidia and microconidia of *T. cavernosa* resemble those of *Muiogone* Thaxter, although the development is somewhat different. In *Muiogone* several transverse cell divisions of an internally proliferating filament are followed by divisions perpendicular to the first plane. In *T. cavernosa* one to several of the septate hymenial cells become inflated and diverge apically (Fig. 9). Cell divisions in two planes lead to the development of macroconidial structures with all tiers less pronounced than in *Muiogone* (Fig. 10,11,12). The function of the macroconidia and occasional microconidia produced at the appendages is assumed to be that of infection, although microconidia could serve as spermatia.

Termitariopsis cavernosa is similar in habit and some microscopic characters to species of the termitophilous genera *Termitaria* Thaxter and *Mattirolella* Colla. All three are sporodochial with black excipular cells, haustoria, basal layers with haustorial mother cells, and pseudoparenchymatous subhymenia (Colla, 1929; Khan, 1973; Khan and Kimbrough, 1973a, 1974b, Khan and Aldrich, 1973, 1975). Species of these genera are virtually indistinguishable at dissecting microscope magnifications, but basic internal differences are easily discerned at higher magnifications. The basal layer cells are all thick-walled in *T. cavernosa* and species of *Mattirolella*, while only some cells of this layer are thick-walled in *Termitaria* species. An epihymenial layer also characterizes *Mattirolella*. Internal sporodochial structure is clearly different in these genera. Only phialoconidia are present in *Termitaria*; phialoconidia and columns of sterile hyphae which form chambers, in *Mattirolella*; and macroconidia arising from a low hymenial layer, in *T. cavernosa*. The presence of what appear to be phialoconidia in some of the exicipular cells and absence of them within the exicipular cavity in *T. cavernosa* further serves to distinguish this species from those of the other two genera.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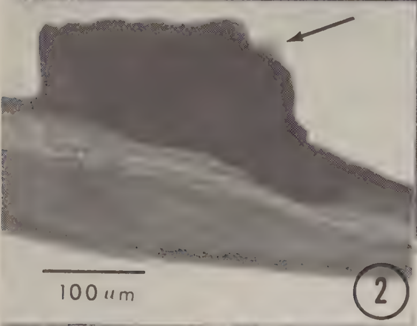
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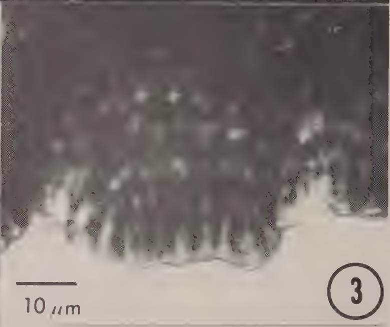
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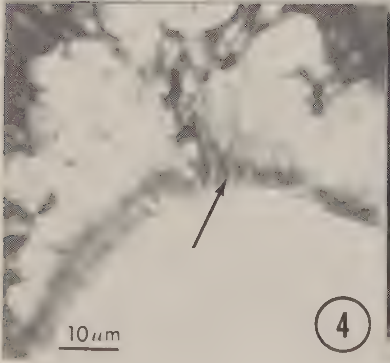
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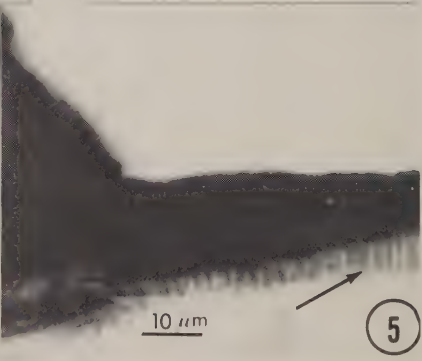
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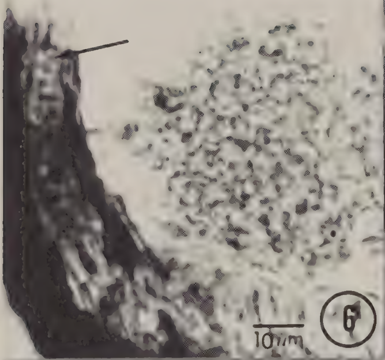
Another sporodochial fungus, *Aegeritella superficialis* Balazy et Wiśniewski, has been described on ants of the genus *Formica* L. from Poland (Balazy and Wiśniewski, 1974) and reported from Italy on the same ant genus (Wiśniewski, 1977). The pale brown sporodochia have a different morphology from those of *Termitariopsis* and produce one-celled blastospores.

Until recently many ectoparasitic fungi known from termites were considered to be restricted to termite species and were not known to have morphological affinities with fungi on other insects. Blackwell and Kimbrough (1978) described *Hormiscioideus filamentosus* occurring on Brazalian termites and discussed its possible relationship to small filamentous ectoparasites of several other arthropods. Unfortunately, morphological simplicity makes it difficult to distinguish characters which denote relationship from those which arise by convergence under selection for a similar habitat. Kimbrough (unpublished) has found *Dimeromyces isopterus* Kimbrough, *Laboulbeniopsis termitarius* Thaxter, and *Coreomycetopsis oedipus* Thaxter, not only on termites, but also on mites and staphylinid beetles which were associated with the termites in a parasitic or commensal relationship. Examples of laboulbeniomycetous fungi known to infect several arthropods that are found in such parasitic or commensal assemblages are cited by Thaxter (1924), Blum (1924), and Benjamin (1965, 1971).

The termitophagous habit of some species of *Neivamyrmex*, the similar habitat and present overlapping ranges of these ants and the subterranean termite genus *Reticulitermes*, make it possible that *Termitaria*, *Mattirolella*, and *Termitariopsis* may have been derived from a common ancestor which was capable of infecting several species of insects living in these conditions. Speciation leading to the three genera could have occurred in different parts of an ancestoral range. In the case of *Termitariopsis*, if host change did occur, this may have limited gene flow in the manner described by Bush (1969) and lead to additional divergence from the ancestoral form, Benjamin (1967, 1968).

Figures 1-5. *Termitariopsis cavernosa*. Fig. 1. Fungal thallus on leg of *Neivarmymex opacithorax*. Excipular cells are closed over the margin (arrow) of the sporodochium at early stages. SEM. Fig. 2. Fungal thallus on leg of *N. opacithorax*. Macroconidium shown emerging (arrow) from partially broken sporodochium. Fig. 3. Crustose layer of thick-walled basal cells. Fig. 4. Cross section through basal layer of sporodochium showing dark excipular cells and pseudoparenchymatous subhymenium above the basal layer. Arrow indicates layer of cuticle from insect. Fig. 5. Longitudinal section through fungal thallus and insect cuticle showing haustoria (arrow).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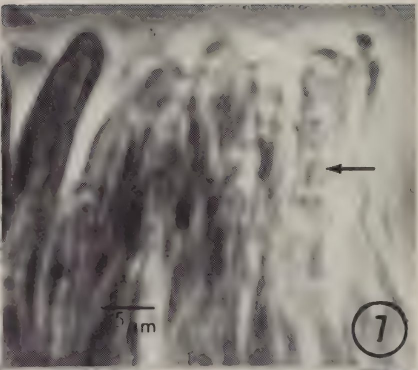
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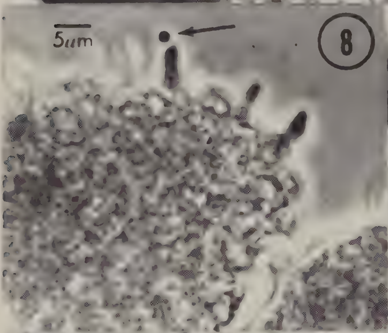
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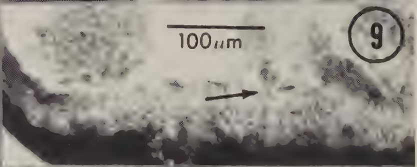
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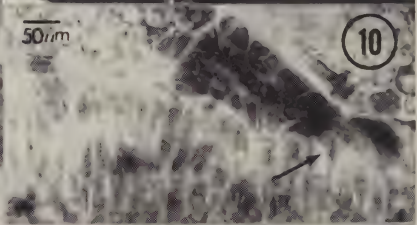
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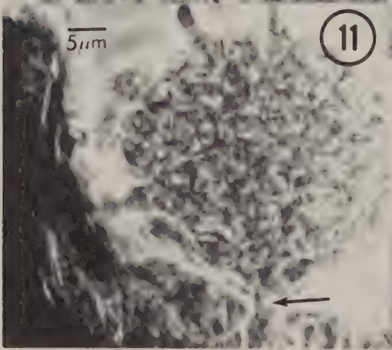
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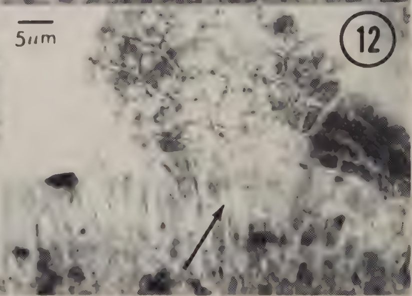
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ACKNOWLEDGMENTS

We are grateful to Dr. Carl W. Rettenmeyer, Department of Systematic and Evolutionary Biology, University of Connecticut, Storrs, Connecticut, for calling our attention to his interesting collections of fungi and for providing us with information on the biology of these insects. Mrs. Maura Reynolds and Dr. Albert Bell, Hope College, Holland, Michigan, kindly translated the descriptions into Latin.

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Figures 6-12. *T. cavernosa*. Fig. 6. Macrocondium within sporodochial cavity with single cell of attachment to septate filaments of the hymenial layer. Arrow denotes phialoconidium-like cells within excipular filaments. Fig. 7. Excipular filaments with phialoconidium-like contents. Fig. 8. Multicellular, appendaged macroconidium with a single microconidium (arrow). Fig. 9. Earliest stage of macroconidium (arrow) observed. Note divergent apex. Fig. 10. Later stage of macroconidial development. Note the attachment to septate filament (arrow). Fig. 11. Macroconidium with attachment at a single filament (arrow). Fig. 12. Macroconidium with attachment at several filaments (arrow).

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PHYSALACRIA LUTTRELLII BAKER EST UNE TYPHULA

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SUMMARY

As proven by the presence of a basal sclerotium, Physalacria luttrellii Baker is in fact a Typhula.

Typhula luttrellii (Baker) comb. nov. is a new member of the subgenus Cnazonaria Corda because of the morphology and the structure of its basidiocarps and because of its gelatinous sclerotia with an inversed epidermoid structure.

INTRODUCTION

A l'occasion d'une révision des espèces du genre Physalacria, nous avons été amené à étudier le spécimen type d'une espèce décrite par Gladys BAKER (1946), Physalacria luttrellii, et conservé au NEW YORK BOTANICAL GARDEN (NY).

Ce champignon récolté par E.S. LUTTRELL en Géorgie (U.S.A.) n'est en aucune façon une Physalacria puisque sa clavule, bien que renflée, est recouverte d'un hyménium dépourvu de cystides (contrairement aux observations de G. BAKER) et que son stipe naît d'un sclérote (non reconnu comme tel par G. BAKER).

La structure de ce sclérote, associée aux caractéristiques du carpophore, indique qu'il s'agit là d'une véritable Typhula, qui ne s'identifiant à aucune des espèces décrites jusqu'alors dans ce genre, mérite la dénomination de Typhula luttrellii (Baker) Berthier.

La description que nous en donnons récapitule nos observations personnelles faites sur exsiccata.

DESCRIPTION

TYPHULA LUTTRELLII (Baker) nov. comb.

Basionyme = Physalacria luttrellii Baker, Mycologia 1946, 38: 636; Corner, Suppl. Monogr. Clav., 1970 : 193.

Spécimen examiné = leg. E.S. Luttrell n° 5153 TYPUS (NY) Spalding County, Georgia (U.S.A.), sur tiges mortes de Lespedeza bicolor, 27- X-1943.

Carpophores ne dépassant pas 1,8 mm, à clavule renflée, piriforme voire globuleuse, portée par un stipe assez court souvent brunâtre à sa base et naissant d'un sclérote visible quand il a fait céder la couche superficielle du support ligneux.

Sclérote gélifié à épidermoïde inversé, non orné, à cutis réduit; vu par-dessus, l'épidermoïde présente de petites cellules fortement engrenées pourvues de nombreux crochetons.

Pour sa part G. BAKER, bien que ne reconnaissant pas l'individualité du sclérote, avait noté une structure particulière à la base des carpophores comme l'indiquent son illustration (fig. 23) d'une section longitudinale de carpophore ainsi que sa description puisqu'elle écrit: "The basal region (of the stipe) is of prosenparenchyma cells covered on the outer surfaces by dark brown pseudoparenchyma cells".

Clavule entièrement fertile, à trame non gélifiée fortement lacuneuse constituée d'hyphes rayonnantes, ramifiées, anastomosées (x 4-5 µm), renflées au niveau des cloisons (x 7-8 µm) dont chacune porte une boucle; les ultimes ramifications de ces hyphes à paroi très peu épaisse sont plus étroites (x 3-4 µm) et portent l'hyménium.

Au niveau de l'hyménium, nous n'avons pas noté la présence des cystides cylindriques et émergentes (40-50 x 6-7,5 µm) signalées par G.BAKER, mais seulement des basides et basidioles de plus grande taille que celles décrites par ce mycologue.

Basides tétrasporiques, nettement claviformes voire spatulées, à cloison basale bouclée, 20-30-35 x 8,5-9-9,5 µm (G. BAKER: 15-18 x 7-9 µm).

Basidioles jamais fusiformes contrairement à celles des Physalacria.

Spores ellipsoïdes, à petit apicule et à paroi amyloïde, 8-9-9,5-10 x 4-4,25-4,5 µm (G. BAKER: 8-11 x 4-5 µm).

Stipe pourvu d'une écorce bien distincte et gélifiée, épaisse de 20-30 µm, faite de fibres (x 3-4,5 µm) à paroi

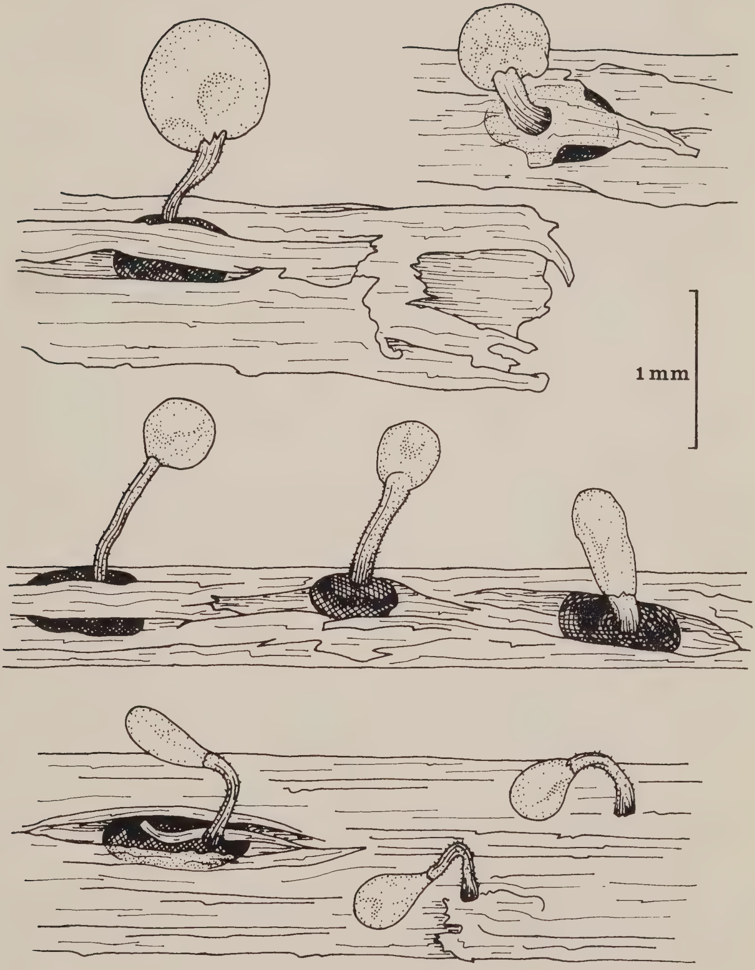

Figure 1 : TYPHULA LUTTRELLII, carpophores (d'après exsiccata).

propre un peu épaisse (0,5-0,75 µm) unies par une gelée évidente; moelle peut-être faiblement lacuneuse, constituée d'hyphes (x 2,5-3-4 µm) à paroi très peu épaisse.

Poils plus ou moins nombreux selon les carpophores; poils à base étroitement et hautement conique (x 3-5 µm) surmontée de prolongements grêles (x 1-1,5 µm), ramifiés, pouvant atteindre 100 µm de long.

DISCUSSION

La méprise de G. BAKER tient au fait que ce mycologue, abusé par la clavule renflée des carpophores conférant à ce petit champignon une allure de Physalacria, a d'une part cru distinguer des cystides dans l'hyménium et d'autre part mal interprété la structure particulière située à la base du stipe et qui correspond en réalité à un sclérote.

La présence de cet organe de résistance de petite taille souvent dissimulé dans le support et dont sont pourvues de nombreuses Typhula, a souvent échappé aux investigations des mycologues comme nous avons pu le constater lors de notre étude monographique du genre Typhula (BERTHIER 1976). Pourtant ainsi que nous l'avons montré la connaissance de la structure des sclérotes s'avère indispensable pour reconnaître l'appartenance des espèces à l'un des sept sous-genres distingués chez les Typhula et par là même faciliter la détermination.

Ainsi, le sclérote de T. luttrellii présente l'un des trois types fondamentaux de structure reconnus chez les Typhula, et particulièrement le plus original d'entre eux en raison de la nature de son épidermoïde qui caractérise, déjà à lui seul, le sous-genre Cnazonaria. En effet, une bordure de sclérote constituée d'un épidermoïde inversé (orné ou non) surmonté d'un cutis ne se rencontre que chez les espèces de ce sous-genre dont par ailleurs le sclérote est toujours gélifié.

Outre les caractéristiques de son sclérote, T. luttrellii présente tous les autres traits des Cnazonaria Corda, tels que nous les avons redéfinis et dont témoigne le type, T. setipes (Grev.) Berthier, à savoir :
carpophores à clavule bien marquée, peu ou pas gélifiée, portée par un stipe à écorce importante, gélifiée et bordée de fibres; spores amyloïdes (sauf chez T. lutescens Boud.). De plus, selon que les cellules de l'épidermoïde inversé du sclérote portent ou non de petites protubérances internes responsables d'une ornementation, nous avons distingué deux groupes parmi les Cnazonaria: T. luttrellii se rattache à celui des "Cnazonaria à épidermoïde non orné".

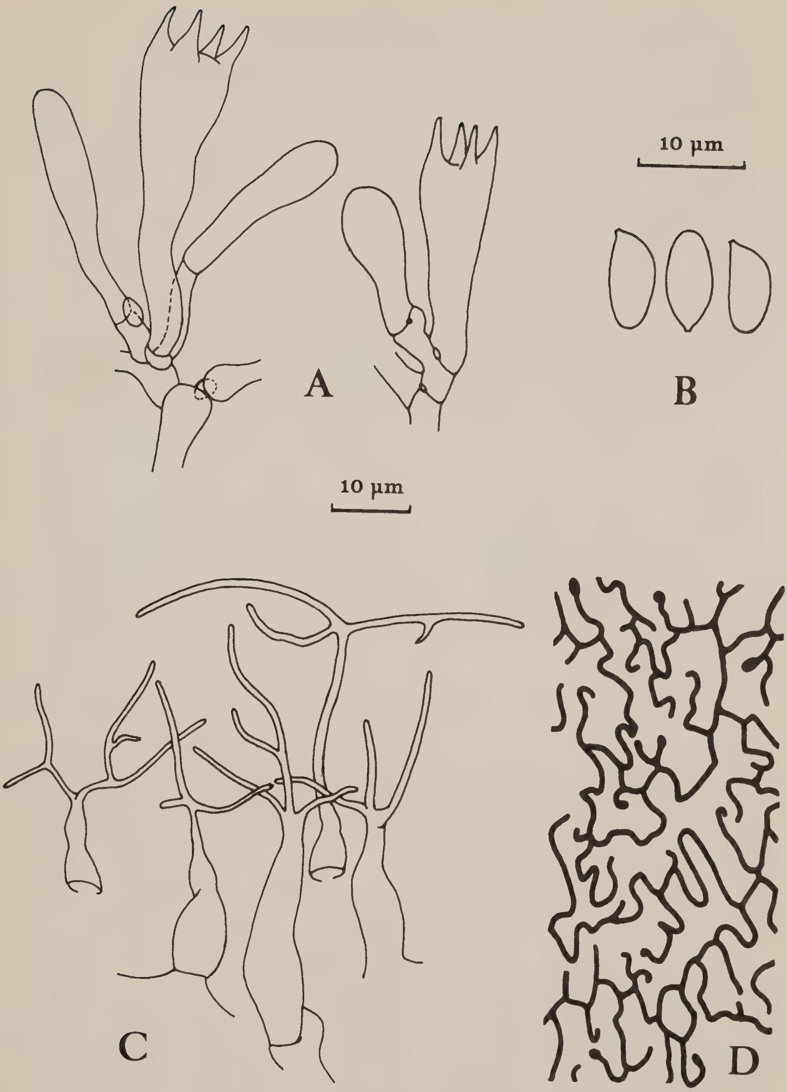
10 µm
A
B
10 µm
C
D

Figure 2 : TYPHULA LUTTRELLII

A- basides et basidioles; B- spores
C- poils du stipe; D- sclérote: bordure vue par-dessus.

Comme c'est le cas pour la majorité des espèces de cette "section", les hyphes du carpophore et du sclérote de T. luttrellii sont bouclées, à l'inverse de ce que l'on observe chez les Cnazonaria à sclérote orné.

Ainsi que nous en faisions état en 1976, à l'exception de T. elegans (Berk. et Curt.) Corner, champignon qui se singularise par ses carpophores particulièrement courts, trapus et à sclérote volumineux, toutes les autres espèces (10) de cette section diffèrent assez peu de celles à épidermoïde orné; il en est de même de T. luttrellii pour laquelle, néanmoins, toute synonymie nous paraîtrait hasardeuse. L'espèce dont elle se rapproche le plus est T. sphaeroidea Remsb. venant sur tiges de Rubus (U.S.A.: état de NY) qui possède des spores plus grandes, 10,5 - 12 x 4,5 - 6 µm et des basides moins renflées à leur sommet, 25-35 x 7-8 µm. D'ailleurs le trait le plus remarquable de T. luttrellii semble bien être ses basides nettement claviformes voire spatulées.

Nous pouvons donc conclure que le champignon appelé Physalacria luttrellii par G. BAKER appartient en réalité au genre Typhula où il se classe dans la section "à épidermoïde non orné" du sous-genre Cnazonaria.

REMERCIEMENTS

Nous exprimons notre gratitude au Professeur E.J.H. CORNER pour la lecture critique de cette note, ainsi qu'au Conservateur du New York Botanical Garden pour le prêt du spécimen décrit.

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UNE NOUVELLE TREMELLALE CLAVARIOIDE : HETEROCEPHALACRIA SOLIDA GEN. ET SP. NOV.

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SUMMARY

Heterocephalacria solida Berthet, a new species, is described and illustrated from a collection made in Colorado (U.S.A.). This capitate clavarioid fungus, having partially cruciately septate apices of the basidia and secondary spores (conidia) is a new member of the Tremellales.

INTRODUCTION

Au cours d'une étude comparative des espèces de *Physalacria* (petites Clavariacées capitées à "oléocystides") nous avons eu l'occasion d'examiner une récolte de F.E. et E.S. CLEMENTS provenant du Colorado (U.S.A.) et étiquetée *Physalacria solida* Clements.

Ce champignon plutôt humicole, à allure de *Physalacria* diffère des espèces de ce genre par sa clavule pleine, recouverte d'un hyménium dépourvu de cystides et constitué de basides subtremelloïdes.

Ces différences n'avaient pas échappé à Gladys BAKER (1941) qui excluait des *Physalacria* ce champignon, alors déposé à HARVARD (FH) en écrivant à son sujet:
"The specimen seen did not present typical physalacrian characters, in particular the basidia, which were apparently a heterobasidial type".

En effet, les basides claviformes de ce champignon, se cloisonnent en croix, à leur extrême sommet seulement. Ce phénomène peu courant se rencontre néanmoins chez d'autres champignons, corticioides comme *Metabourdotia* (OLIVE, 1957), clavarioides comme *Tremellodendropsis* (CORNER, 1953 et 1966,

A. CRAWFORD, 1954) et cyphelloides comme Heteroscypha (AGERER et OBERWINKLER, 1979).
Mais le spécimen de CLEMENTS avec ses carpophores simples et capités, ne ressemble en rien aux Tremellodendropsis qui ont tous, comme T. tuberosa espèce type du genre, des carpophores clavarioides rameux.

Cette espèce est donc le représentant d'un genre nouveau, Heterocephalacria, dont la position systématique sera discutée plus loin après que nous ayons décrit les caractéristiques de Heterocephalacria solida Berthier, malheureusement de façon incomplète puisque issues de la seule étude de spécimens secs.

DESCRIPTION

Spécimen examiné:
Physalacria solida F.E et E.S Clements in herbarium leg. F.E et E.S Clements n° 333(S) ex herb. Sydow, Minnehaha 2600 m, Colorado (U.S.A.), 7-IX-1906. "Geophilus gregarius ad terram et ad acus Pseudotsugae semel Picea-Pseudotsuga-hylio".

Espèce non décrite par ses auteurs mais répertoriée dans Cryptogamae Formationum Coloradensium (Univ. Colorado Museum 1972).

Carpophores simples, dressés, élancés, atteignant 18 mm, avec une clavule brutalement séparée du stipe; carpophores venant en petits groupes de 3-6 individus, sur la terre ou des rameaux de conifères.

Sur le sec, carpophores de couleur havane avec un stipe (MU. 7,5 YR 4/4-3/2) plus sombre que la clavule (MU. 7,5 YR 5/4-5/6). Stipe très long, régulier (x 0,2 - 0,3 mm) et comprimé; clavule (x 1,2 - 1,5 mm) droite ou réfléchie et présentant souvent deux lobes qui enserrent le stipe.

Clavule pleine recouverte d'un hyménium amphigène, dépourvu de cystides.
Trame de la clavule, lacuneuse et constituée d'hyphes lâchement enchevêtrées, régulières (x 3-5-7 µm) à paroi mince ou peu épaisse, à cloisons sans boucles.
Sous-hyménium peu épais, non lacuneux fait d'hyphes plus étroites (x 3-5 µm) à articles courts et à cloisons pourvues de boucles.

Basides et basidioles claviformes, à cloison basale bouclée et à sommet souvent partiellement cloisonné en croix; cloisonnement apical plus ou moins précoce: précédant ou non la poussée des stérigmates; parfois pas de cloisonnement même chez les basides mûres ou agées.
Basides tétrasporiques, plus ou moins longuement claviformes, 25-30-35 µm x 6-7-8 µm au sommet, x 2-3 µm à la base.

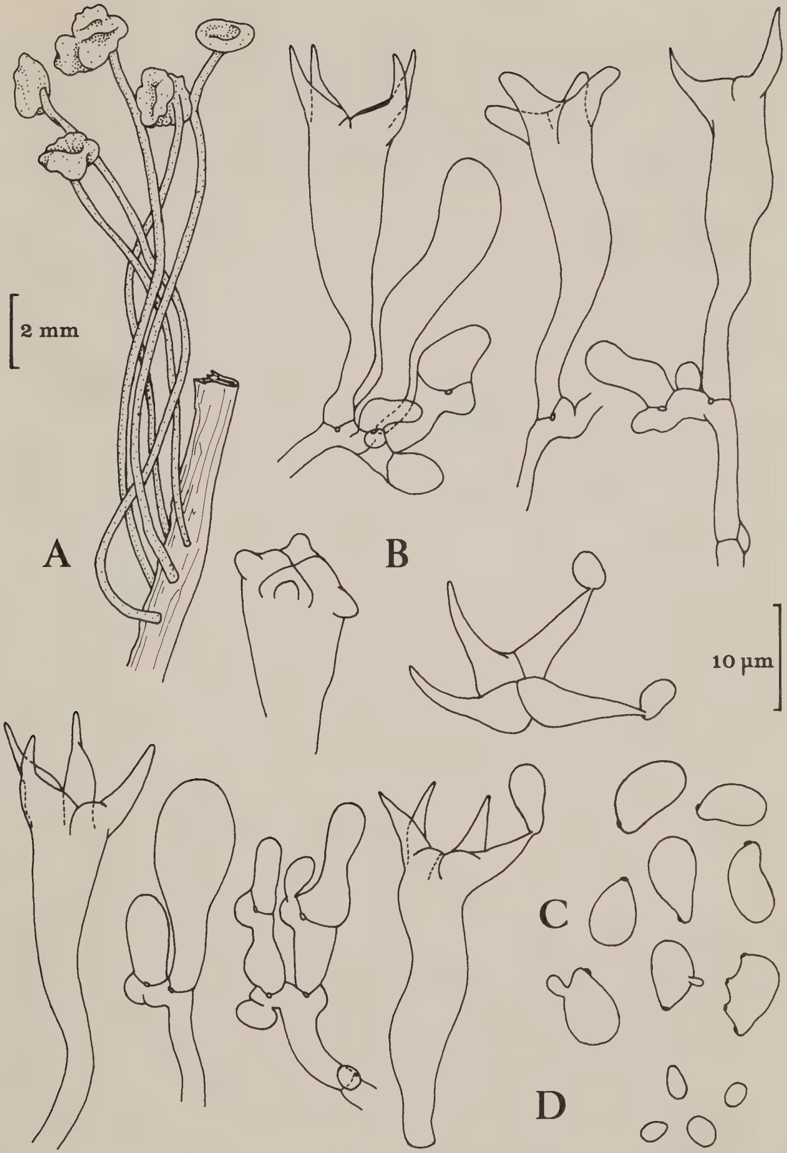

Figure 1 : HETEROCEPHALACRIA SOLIDA

A- carpophores (d'après exsiccata); B- basides et basidioles.
C- basidiospores, spores produisant des conidies; D- conidiospores.

Stérigmates longs et à base large, en forme de cornes.

Basidiospores hyalines, à paroi mince non amyloïde, 7-8-(10) x 3,25 - 3,5 - (3,75) µm, caractériséespar un apicule si court qu'il passerait inaperçu sans l'existence du bouchon apiculaire primaire. Basidiospores non répétitives semble-t-il mais cependant capablesde produire, sans cloisonnement préalable, des conidies en un ou plusieurs points.

Conidiospores ellipsoïdes, 3-4 x 1,5 -2 µm, se détachant facilement comme en témoignent les courtes cicatrices observées sur quelques basidiospores.

Stipe glabre, comprimé, plein, cortiqué et gélifié, constitué d'hyphes régulières à paroi un peu épaisse et à cloisons sans boucles.

Au niveau de l'écorce, épaisse de 10-15 µm, hyphes (x 2,5 - 4,5 µm) unies par une gelée abondante.

Plus à l'intérieur, hyphes seulement unies par un très mince gel; hyphes étroites (x 1,5 - 3 µm) dans une zone de 15 µm sous l'écorce, hyphes plus larges (x 3-4-5-(7) µm) au niveau de la moelle qui n'est pas lacuneuse.

HETEROCEPHALACRIA nov. gen.

Carpophori simplices, erecti, clavula a stipite maxime distincta. Basidiis claviformibus, breviter in crucem in summa parte septatis. Basidiosporis hyalinis, haud repetitivis, potentibus conidiosporas gignendi.

Genus clavarioideum inter Tremellales collocandum.

Typus generis: *Heterocephalacria solida* Berthier

Heterocephalacria solida nov. sp.

Carpophori 18 mm alti, catervatim in terra nuda vel ramis coniferarum crescentes, sicci brunnei, clavula 1,2 - 1,5 mm lata, saepe bilobata, stipitem longum atque compressum includente, plena, sed lacunosa, hymenio amphigene, cystidiis orbato. Basidiis claviformibus, summis plerumque breviter septatis, 4 robustis sterigmatis. Basidiosporis hyalinis, haud amyloideis, 7-8-(10) x 3,25-3,5(3,75) µm, appendice per obturamentum apicularem primarium separabili. Basidiosporis haud repetitivis, potentibus parvas conidiosporas (3-4 x 1,5-2 µm) gignendi, sine septatione praecedente. Stipite glabro, pleno, cortice gelata. Hyphis regularibus, haud inflatis. Septis solum prope hymenium subhymeniumque fibulatis.

Holotypus: Stockholm (S) leg. F.E et E.S Clements n° 333. Humi vel in ramis coniferarum, Minnehaha, 2600 m, Colorado (U.S.A.), 7-IX-1906.

DISCUSSION

Heterocephalacria solida, avec ses carpophores simples et capités présente de plus les caractéristiques suivantes:

- une gélification au niveau du stipe, particulièrement nette dans l'écorce.
- des boucles limitées aux cloisons des hyphes du sous-hymé-

nium et au pied des basides.

- des basides claviformes, le plus souvent courtement cloisonnées en croix à leur sommet.
- des basidiospores produisant des spores secondaires de type conidie, sans cloisonnement préalable.

Ces deux dernières caractéristiques nous conduisent à nous interroger sur la position du genre *Heterocephalacria*.

Avec ses forts stérigmates bien individualisés par le cloisonnement apical, la baside de *H. solida* n'est pas sans évoquer la baside des Dacrymycétales, qui est toutefois régulièrement bisporique et jamais cloisonnée. De plus chez les Dacrymycétales, la production de conidies par les basidiospores, qui sont également non répétitives, est très généralement précédée d'un cloisonnement.

H. solida diffère aussi des Trémellales typiques, pourtant à basides cloisonnées, car celles-ci, globuleuses et complètement cloisonnées en croix, produisent des basidiospores répétitives capables dans certains cas de germer en conidies.

En dépit de ces réserves, nous pouvons rattacher notre espèce aux Trémellales, si nous nous réfèrons à la classification de MC NABB (1973) qui oppose les Holo aux Phragmobasidiomycetidae. Ce partage, antérieurement proposé par PATOUILLARD (1887, non 1900) et BREFELD (1887) sous d'autres vocables, respectivement Homo/Héterobasidiés et Auto/Protobasidiés, a été actualisé pour tenir compte d'espèces récentes à basides partiellement cloisonnées en croix et que MC NABB rattache aux Trémellales:
Metabourdotia (1 espèce), *Tremellodendropsis* + *Pseudotremellodendron* (5 espèces), auxquels vient s'ajouter *Heteroscypha* (1 espèce).

Soulignons ici que contrairement à ce que laisse supposer la définition élargie des Trémellales donnée par MC NABB il n'est pas certain que la production de spores répétitives soit le fait de toutes les espèces.
Tel serait le cas de *H. solida*, tout comme celui des espèces clavarioïdes chez lesquelles CORNER (1966 et 1970) n'a jamais observé ce phénomène. C'est pourquoi notamment, cet auteur, bien que reconnaissant la filiation probable de *Tremellodendron* (Tremellales), *Tremellodendropsis* et *Aphelaria* (Aphyllophorales, Clavariacées), hésite à verser ce genre limite dans les Trémellales.
De toute façon notre nouveau genre, vient s'ajouter à ces quelques espèces limites qui semblent être les témoins de l'évolution des Holobasidiés à partir d'ancêtres Phragmobasidiés.

REMERCIEMENTS

Nous adressons nos plus vifs remerciements au Professeur E.J.H. CORNER pour la lecture critique de cette note, à H. ROMAGNESI pour la traduction latine, ainsi qu'au Conservateur du Muséum d'Histoire Naturelle de Stockholm (S) pour le prêt du spécimen décrit.

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BOTRYOBASIDIUM CHILENSE SP. NOV., A TELEOMORPH OF HAPLOTRICHUM CHILENSE

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ABSTRACT

A new species, Botryobasidium chilense Hol.-Jech., is described and illustrated from the type material of its anamorph Haplotrichum chilense (Linder) Hol.-Jech. (= Oidium chilense Linder) collected in Chile. It is closely related to Oidium ochraceum (Povah) Linder; the latter name is transfered to Haplotrichum Link.

TAXONOMIC PART

Botryobasidium chilense Hol.-Jech. sp. nov.

Carposoma resupinatum, sparse arachnoideum usque hypochnoideum, 75 - 100 µm crassum, album vel albo - cremeum. Hyphae basales 6 - 9 µm crassae, hyalinae, crassitunicatae, paulo dextrinoideae et valde cyanophilae, subhymeniales 6 - 7 µm crassae, tenuitunicatae, omnes absque fibulis; cystidia absunt. Basidia ellipsoidea vel ovoidea, 13 - 15 x 7 - 8 µm, tenuitunicata, (6-) 8 sterigmatibus 3 - 4 µm longis instructa. Basidiosporae 6 - 7.5 x 3 - 3.5 µm, ellipsoideae usque fusiformes, apiculo laterali instructae, hyalinae, tenuitunicatae, non-dextrinoideae, paulo cyanophilae.

Typus: Chile, Punta Arenas, Magallanes; March 1906,
leg. R. Thaxter (FH - Holotypus, cum anam.
Haplotricho chilensi).

Carpophores resupinate, widely effused, loosely hypochnoid, about 75 - 100 µm thick, white when fresh, somewhat whitish - ivory when dry.

Basal hyphae (5-) 6 - 9 (-10) µm wide, hyaline, thick-walled, with slightly dextrinoid and strongly cyanophilous walls; the ascending hyphae 6.5 - 7 µm wide with walls cyanophilous and undextrinoid; subhymenial hyphae 6 - 7 µm wide, thin-walled. All hyphae clampless, rarely anastomosing, without incrustation. Cystidia lacking.

Basidia ellipsoidal to ovoid, somewhat inflated and rounded at the top, narrowed toward the base, 13 - 15 µm long, 7 - 8 µm wide in the widest part, 3.5 - 4 µm wide near the base, thin-walled, with cyanophilous and slightly dextrinoid or undextrinoid walls, with (6-) 8 sterigmata, 3 - 4 µm long and 1 - 1.5 µm wide at the base.

Basidiospores usually 6 - 7.5 x 3 - 3.5 µm, ellipsoid to fusiform, slightly concave, narrowed to the apex and apiculately terminated in the top, broadly rounded at the base with a lateral and prominent basal apiculus, thin-walled, smooth, undextrinoid, slightly cyanophilous.

Anamorph: Haplotrichum chilense (Linder) Hol.-Jech.,
Česká Mykol. 30: 3, 1976.

Basionym: Oidium chilense Linder,
Lloydia 5: 196, 1942.

Colonies effused, irregular, thin, hypochnoid, loosely cottony or only scattered groups of conidiophores, whitish to slightly ochraceous, slightly ochraceous - brown or ochraceous - grey, 150 - 300 µm thick, hardly separable from the substratum.

Basal hyphae hyaline, (6-) 7 - 9 (-10) µm wide, thick-walled (up to 1 µm), prostrate and immersed in the substratum, few-branched, septate, clampless, occasionally anastomosing.

Conidiophores erect and ascending, at first unbranched, later branched in basal parts only, with ascending branches longer than the main conidiophore; hyaline, yellowish in basal parts, thick-walled (up to 1 µm), slightly constricted in the terminal septa, 130 - 275 µm long and (6-) 8.7 - 10 (-11) µm wide at the base, narrowed in terminal parts, 6 - 7.5 µm wide, terminated in one or more conidiogenous cells.

Conidiogenous cells slightly vesiculose, ellipsoid to broad ellipsoid, in short chains, or quite indistinct from the terminal part of conidiophore, hyaline or pale yellowish, with sometimes slightly granulose content, (14-) 17 - 26 (-30) x (6.5-) 7.5 - 10 µm, with 1 - 5 terminal and lateral conidiogenous teeth. Conidiogenous teeth cylindrical, short, 1 - 1.5 µm long and 2 - 3 (-4) µm wide, or developed only as slightly raised scars.

Conidia hyaline or pale yellowish, ovoid to broad ellipsoid or lemon-shaped, rounded at the terminal part and tapered, truncate or apiculate at the basal end, (11-) 13.5 - 16 (-18) x (7.5-) 9 - 11 µm, thick-walled (up to 1 µm), borne sessile or on teeth, in short, simple or branched chains; the wall of conidia finely echinulate to minutely verrucose.

Walls of basal hyphae and of mature conidia are slightly dextrinoid in Melzer's Reagent; those of basal hyphae, conidiophores and conidia are strongly cyanophilous in Cotton Blue.

Specimens studied:

1) Chile: Punta Arenas, Magallanes; III. 1906, coll. R. Thaxter (FH - Typus of *Botryobasidium chilense* and *Haplotrichum chilense*).
2) New Zealand: Westland, Granville Forest, Mount Elliott, Ahaura; on a wood chip, 2.IV. 1963, coll. S.J. Hughes (625) (DAOM 117434; only *Haplotrichum* anamorph).

Habitat and distribution.

Growing on dead and rotting wood. Its ecology and distribution is not clear yet, because only two records are known for the time being, one from Chile, one from New Zealand.

Remarks.

During the study of the type specimen of *Haplotrichum chilense* (FH), collected by R. Thaxter and determined and described by D.H. Linder (1942), also its teleomorph belonging to *Botryobasidium* Donk subgen. *Brevibasidium* John Erikss. was found. Unfortunately, the material of the teleomorph was rather infrequent and overmatured in the specimen studied. However, it was possible to find the connection between the teleomorph and the anamorph in the margin of young colonies of *Botryobasidium*; this connection was established between basal hyphae of both states.

Botryobasidium chilense may be a species distinguishable with some difficulty as it is rather similar to other species of *Botryobasidium* subgen. *Brevibasidium*, e. g. *B. candicans* John Erikss., the teleomorph of *Haplotrichum capitatum* (Pers.) Link, with spores more or less of the same shape and size as *B. chilense*, but with somewhat longer and narrower basidia. Chiefly, *B. chilense* is rather well-marked by its anamorph.

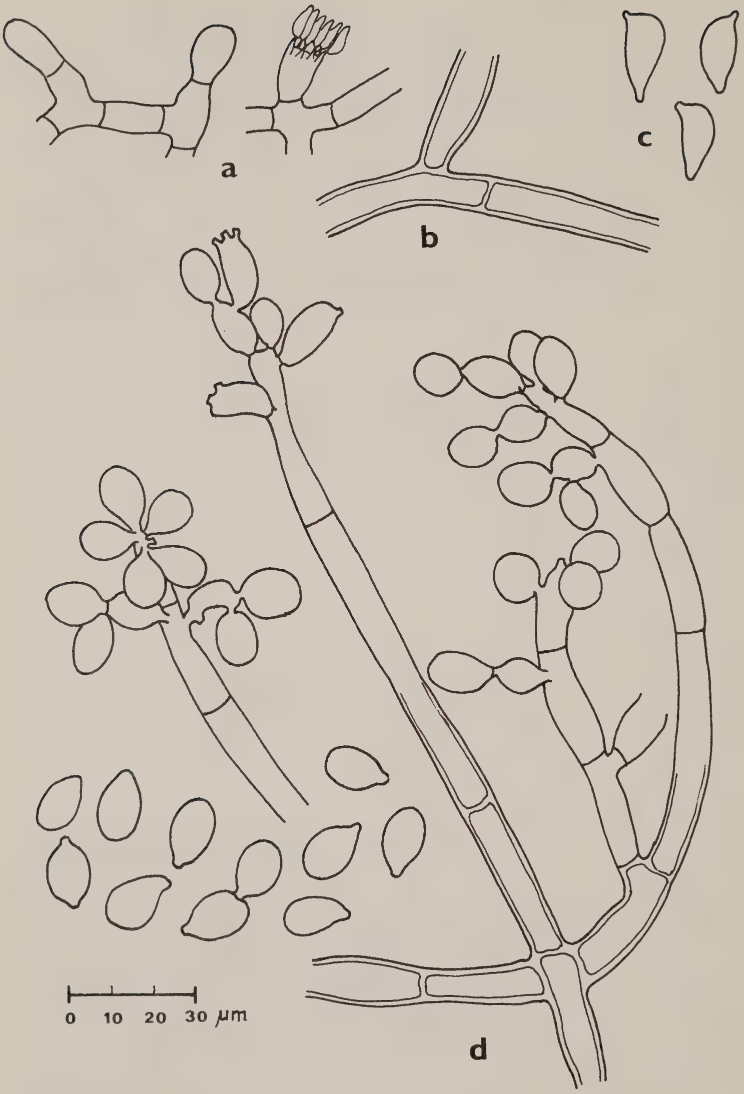

Fig. 1. Botryobasidium chilense with its anamorph Haplotrichum chilense. a) Hymenial hyphae with basidia, b) basal hypha, c) spores of B. chilense. d) Conidiophores and conidia of H. chilense.

Haplotrichum chilense seems to come close to H. capitatum, but has less distinct conidiogenous cells and conidiogenous teeth. H. chilense is very similar to H. ochraceum (Povah) Hol.-Jech. comb. nov. [basionym: Monilia ochracea Povah, Mich. Acad. Arts, Sci., Letters 13: 181 - 182, 1931, = Oidium ochraceum (Povah) Linder, Lloydia 5: 187, 1942]. The latter species is well distinguishable by its thin-walled and longer, (12.5-) 17.5 - 20 (-22.5) x (8-) 8.7 - 10 (-11.2) µm, lemon-shaped to fusiform conidia. H. ochraceum is confined to the North American continent (Maine, Massachusetts, Michigan).

Haplotrichum chilense is known from two specimens only, and therefore the variation of it is not well determined for the time being.

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REVISION AND SUBDIVISION OF HAPLOTRICHUM - ANAMORPHS OF BOTRYOBASIDIUM

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ABSTRACT

Species of Haplotrichum Link (lignicolous Hyphomycetes) are anamorphs of Botryobasidium Donk subgen. Brevibasidium John Erikss. (Corticiaceae). After a revision, the genus includes 22 species; connections to perfect states were found in 10 of them. Haplotrichum is characterized by wide basal hyphae; except for H. medium basal hyphae are without clamps. The most important features used for the subdivision of Haplotrichum are as follows: presence or absence of clamps (subgenera); ramification of conidiophores, mode of conidia production (solitary or in chains), absence or presence and colour of conidiogenous cells, existence of one or two types of conidiophores (sections); shape of conidia, quantity and shape of conidiogenous teeth, ramification of conidiophores (subsection). Colour of colonies, conidiophores and conidia are characters of species only. Features of perfect states cannot be used to subdivide Haplotrichum or to distinguish its species.

INTRODUCTION

Haplotrichum Link belongs to Deuteromycotina, class Hyphomycetes. Species of this genus are anamorphs of Botryobasidium Donk subgenus Brevibasidium John Erikss. (Corticiaceae). They are lignicolous hyphomycetes occurring on dead and rotten wood and bark of dead and fallen trunks, branches and stumps. In general, imperfect states of Basidiomycetes are mostly poorly developed and are often known in pure cultures only; on the contrary anamorphs of Botryobasidium Donk produce elegant forms, morphologically very distinct and variable on the substrate in nature and occurring often there quite separately from their teleomorphs.

The genus was monographed by Linder in 1942, who included 31 species and 1 variety in it. The result of the present revision is a new circumscription of the genus including 22 species only. Linder used in his monograph the name Oidium Link ex Fr. However, following conservation of the generic name Oidium for conidial states of Erysiphe and closely related genera accepted by the XII. International Botanical Congress in July 1975, the name Haplotrichum Link had to be chosen for the genus studied on the basis of priority (Petersen 1975, Holubová -Jechová 1975, 1976). Other important synonyms used often by mycologists for Haplotrichum Link are: Acladium Link ex Pers., Alysidium Kunze, Nematogonum Desm., Physospora Fr., and Rhinotrichum Corda etc.

The revisionary studies are based on a rich material collected in Central Europe, mainly in Czechoslovakia and Poland, and on investigation of types and rich materials from North American continent preserved in some mycological herbaria (FH, NY, BPI, DAOM).

TAXONOMIC PART

Haplotrichum Link is a rather isolated genus. Characteristic features for its delimitation are wide basal hyphae (which indicate its connection with Botryobasidium), and the development of conidia on conidiogenous cells. Conidia are blastospores produced on more or less distinct conidiogenous teeth located on conidiogenous cells, often in long chains. The production of blastospores in chains is a relatively uncommon feature in the Homobasidiomycetes. The most closely related genus is Allescheriella Hennings; its only species A. crocea (Mont.) Hughes is an anamorph of Botryobasidium croceum Lentz and its conidia are aleuriospores. However, in spite of this basic difference, Linder (1942) included Allescheriella in his Oidium.

Microchemical reactions of cell walls with Cotton Blue and with Melzer's Reagent were also used for generic delimitation of Haplotrichum. Cell walls of basal hyphae of Haplotrichum are cyanophilous in Cotton Blue as they are in Botryobasidium. Hyaline parts of conidiophores, conidiogenous cells and conidia of Haplotrichum are also mostly more or less cyanophilous. This feature - cyanophily of hyphal walls in Cotton Blue - has been used for taxonomic conclusions concerning the circumscription of the genus in this revision. Acyanophilous species included by Linder (1942) in the genus were excluded: Oidium lanosum (Cooke) Linder, O. macrosporum (Farlow ex Sacc.) Linder and O. tenellum (Berk. & Curt.) Linder, two latter belonging to Olpitrichum Atk. (Holubová-Jechová 1974).

The majority of species of Haplotrichum show a weak dextrinoid reaction of basal hyphae in Melzer's Reagent, their walls turn violet-brown quite similar as those of Botryobasidium. Some species of Haplotrichum have also strong dextrinoid reaction of the wall of conidia (e. g. H. tenerum).

The infrageneric classification of Haplotrichum.

The genus is not quite homogenous but the species are clustered in several groups. Some species are more related and form complexes of species, other form monotypic groups.

According to the presence or the absence of clamps in basal hyphae, the genus may be subdivided into two groups. One group contains 21 species without clamps, the second group only one species with clamps in basal hyphae. This character was used in the subdivision of the genus into two subgenera: subgen. Haplotrichum without clamps, and Fibulinum with clamps.

The member of subgen. Fibulinum is characteristic not only by this feature, but also usually by the occurrence of the anamorph in carpophores of the teleomorph. The teleomorph and the anamorph are not separated in this species during its ontogenetic development (as it is usual in subgen. Haplotrichum), both states developing in ± equal quantity or one or another predominating. Phylogenetically, this species seems to be the most primitive member of the genus.

The ramification of conidiophores is another significant character for the subdivision of Haplotrichum. Conidiophores are either irregularly branched on whole length in lateral branches, or simple and branched only at base, or they are branched only at apex. Another important feature characteristic only for one species (H. simile) is the presence of two types of conidiophores. The ones are short, branched, hyaline to pale coloured and thin-walled, the others are 2-4 times longer, simple, dark rusty brown and thick-walled. Both types of conidiophores bear conidiogenous cells with chains of conidia. The longer and darker conidiophores are not abundant in colonies and suggest a transition to sterile setae.

Different types of ramification of conidiophores are somewhat correlated with the shape and location of conidiogenous cells and conidiogenous teeth. For example: the conidiophores on the whole length unbranched have intercalary, not swollen usually conidiogenous cells, conidiogenous teeth scattered in the upper two- thirds of conidiophores, and conidia single, not in chains. An example is the Haplotrichum conspersum species complex. On the contrary, the conidiophores branched on the whole length have distinct terminal and lateral vesiculous conidiogenous cells, conidiogenous teeth on the conidiogenous vesicles only and conidia solitary or in short chains. An example is the *Haplotrichum ramosissimum* species complex.

A significant feature for classification is also the shape of conidiogenous cells which may be either very distinct, vesiculose to globose inflated or not at all conspicuous and swollen; according to their position they may be terminal, lateral or intercalary. Also the number, location and shape of conidiogenous teeth, as well as the method of conidia formation, whether they are solitary or in short or long branched chains, are important characters. The complex of all these features was used for the subdivision of subgen. *Haplotrichum* into sections. The sections are not equivalent by the number of species included.

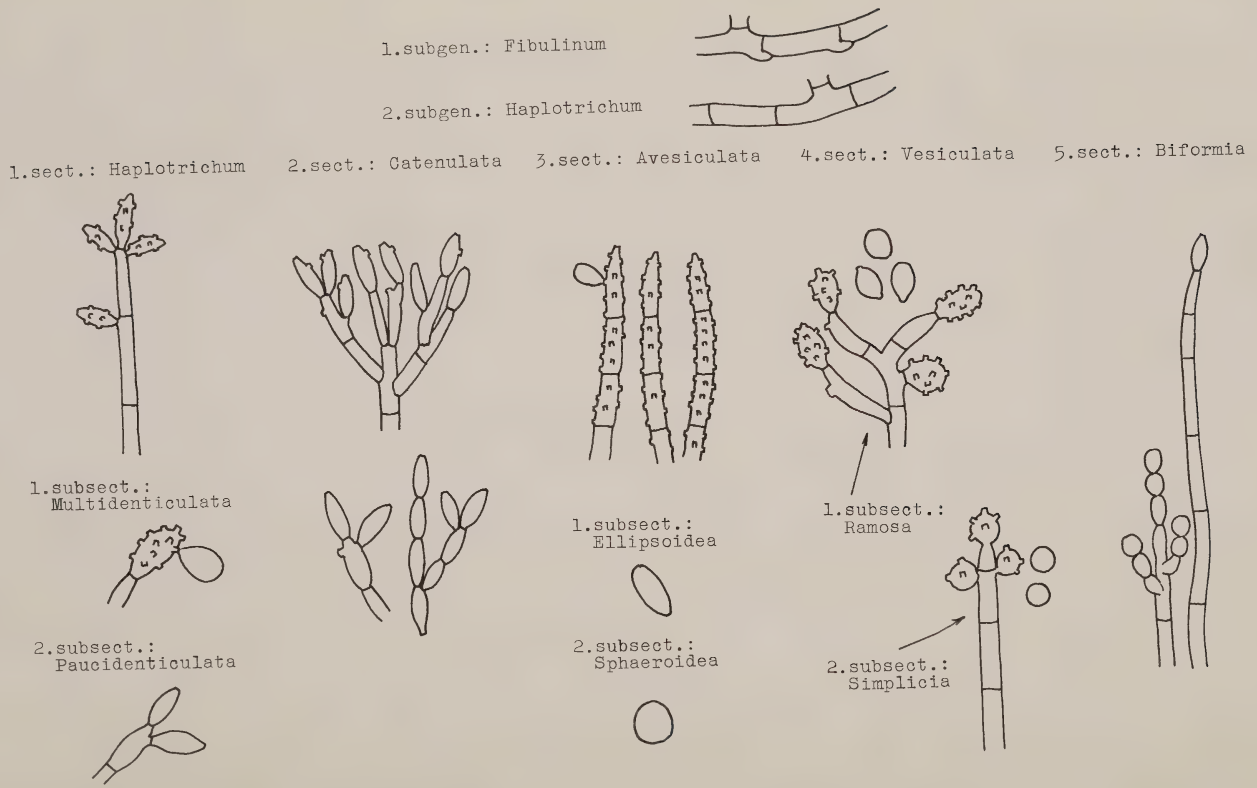
Some of the sections have even been subdivided into subsections. The shape of conidia, shape, number and location of conidiogenous teeth and also some differences in ramification of conidiophores were used as criteria for the delimitation of subsections.

The colour of conidiophores and conidia is an important character for these fungi only at the specific level. The appearance and the colour of colonies of *Haplotrichum* are rather constant features. Only exceptionally moist substrata are influencing this character (for example: *Haplotrichum aureum* has pale yellow colonies on moist substrata and dark orange yellow colonies on dry substrata). Some species of *Haplotrichum* may be safely determined without microscope only according to their habitus and colour of colonies, for example: *Haplotrichum aureum*, *H. simile*, *H. capitatum*, *H. conspersum*.

The genus is cosmopolitan in its distribution. Eight species occur in Europe and nearly all species occur in the North American continent or in Central and South America. Only *H. ovalisporium* and *H. gracile* are known also in Africa and *H. pulchrum* has been found hitherto in Australia only. According to the number of species of *Haplotrichum*, the centre of their abundance is in the North American continent.

Eight species collected in Czechoslovakia were studied in detail. Some of them seem to show special requirements for temperature, moisture and altitude. On the contrary, other species are ecologically very plastic. Very common species in Czechoslovakia are *H. aureum*, *H. capitatum* and *H. conspersum* occurring on wood and bark of deciduous trees from lowlands to the mountains. *H. rubiginosum* and *H. simile* appear to be confined to river-side forests in lowlands of warm regions. *H. ellipsosporum* occurs mainly in mixed and spruce-forests in colder regions from hilly country to the mountains. *H. medium* and *H. album* are rare

SUBDIVISION OF HAPLOTRICHUM LINK


1.subgen.: Fibulinum
2.subgen.: Haplotrichum
1.sect.: Haplotrichum
2.sect.: Catenulata
3.sect.: Avesiculata
4.sect.: Vesiculata
5.sect.: Biformia
1.subsect.: Multidenticulata
2.subsect.: Paucidenticulata
1.subsect.: Ellipsoidea
2.subsect.: Sphaeroidea
1.subsect.: Ramosa
2.subsect.: Simplicia

species known in Czechoslovakia only from a few localities. All species collected in Czechoslovakia, except for H. album, were found in connection with their Botryobasidium teleomorph.

CLASSIFICATION OF HAPLOTRICHUM LINK

Nomen: Haplotrichum Link, in Willd., Linné Sp. Pl., ed. 4, 6 (1): 52, 1824; Fr., Syst. Mycol. 3 (in indice): 93, 1832.

Typus: H. capitatum (Pers.) Link 1824

Status perfectus: Botryobasidium Donk, Meded. ned. mycol. Vereen 18 - 20: 116, 1931.

1. subgenus: Fibulinum subgen. nov.
Typus: H. medium (Hol.-Jech.) Hol.-Jech. 1976

Hyphae basales fibulatae.
Basal hyphae with clamps.

1 sp.: H. medium (Hol.-Jech.) Hol.-Jech. 1976 anamorph of Botryobasidium medium John Erikss.

2. subgenus: Haplotrichum
Typus: H. capitatum (Pers.) Link 1824

Basal hyphae without clamps. (21 spp.)

1. sectio: Haplotrichum
Typus: H. capitatum (Pers.) Link 1824

Conidiophores unbranched or branched in basal parts only, vesiculous distinct conidiogenous cells in short chains in apical parts; conidia in chains. (3 spp.)

1. subsectio: Multidenticulata subsect. nov.
Typus: H. capitatum (Pers.) Link 1824

Pars conidiifera polyblastica, dentibus conidiiferis distinctis, numerosis praedita.
Conidiogenous teeth on conidiogenous cells distinct, numerous.

1 sp.: H. capitatum (Pers.) Link 1824 anamorph of Botryobasidium candicans John Erikss.

2. subsectio: Paucidenticulata subsect. nov.
Typus: H. ochraceum (Povah) Hol.-Jech. 1980

Pars conidiifera polyblastica, dentibus conidiiferis indistinctis, paucis praedita.
Conidiogenous teeth on conidiogenous cells indistinct, not numerous.

2 sp.: H. ochraceum (Povah) Hol.-Jech. 1980,
H. chilense (Linder) Hol.-Jech. 1976
anamorph of Botryobasidium chilense
Hol.-Jech.

2. sectio: Catenulata sect. nov.
Typus: H. aureum (Pers.) Hol.-Jech. 1976

Conidiophora plus minus irregulariter ramosa; cellulae conidiogenae vesiculosae dentibus conidiiferis plus minus indistinctis, paucis praeditae; conidia in catenis longis ramosis disposita.
Conidiophores more or less irregularly branched on the whole length; vesiculous conidiogenous cells present; conidiogenous teeth more or less indistinct and less frequent; conidia in long and branched chains.

2 sp.: H. aureum (Pers.) Hol.-Jech. 1976 anamorph of Botryobasidium aureum Parm.,
H. album (Sumstine) Hol.-Jech. 1976

3. sectio: Avesiculata sect. nov.
Typus: H. conspersum (Pers.) Hol.-Jech. 1976

Conidiophora simplicia; cellulae conidiogenae intercalares, non vesiculosae, dentibus conidiiferis numerosis praeditae; conidia solitaria.
Conidiophores unbranched on the whole length; conidiogenous cells intercalary, not vesiculously swollen; conidiogenous teeth numerous, located in the upper two-thirds of the conidiophore; conidia solitary.
(6 spp.)

1. subsectio: Ellipsoidea subsect. nov.
Typus: H. conspersum (Pers.) Hol.-Jech. 1976

Conidia ellipsoidea vel clavata.
Conidia ellipsoid or clavate.

4 spp.: H. conspersum (Pers.) Hol.-Jech. 1976
anamorph of Botryobasidium conspersum
John Erikss.,
H. ellipsosporum (Hol.-Jech.) Hol.-Jech.
1976 anamorph of Botryobasidium
ellipsosporum Hol.-Jech.,

H. magnisporum (Linder) Hol.-Jech. 1976,
H. caribense (Hol.-Jech.) Hol.-Jech. 1976

2. subsectio: Sphaeroidea subsect. nov.
Typus: H. sphaerosporum (Linder) Hol.-Jech. 1976

Conidia globosa.
Conidia globose.

2 spp.: H. sphaerosporum (Linder) Hol.-Jech. 1976,
H. tenerum (Sumstine) Hol.-Jech. 1976

4. sectio: Vesiculata sect. nov.
Typus: H. ramosissimum (Berk. & Curt.) Hol.-Jech. 1976

Conidiophora ramosa vel simplicia; cellulae conidiogenae terminales et laterales, distinctae, vesiculosae, dentibus conidiiferis praeditae; conidia solitaria vel in catenis brevibus disposita. Conidiophores branched or rarely unbranched; conidiogenous cells terminal and lateral, distinct, vesiculously swollen, with conidiogenous teeth; conidia solitary or in short chains.
(9 spp.)

1. subsectio: Ramosa subsect. nov.
Typus: H. ramosissimum (Berk. & Curt.) Hol.-Jech. 1976

Conidiophora ramosa.
Conidiophores branched.

8 spp.: H. ramosissimum (Berk. & Curt.) Hol.-Jech. 1976,
H. curtisii (Berk.) Hol.-Jech. 1976 anamorph of Botryobasidium curtisii Hallenb.,
H. rubiginosum (Fr.) Hol.-Jech. 1976 anamorph of Botryobasidium robustius Pouz. & Hol.-Jech.,
H. linderi Hol.-Jech, 1976,
H. gracile (Linder) Hol.-Jech. 1976,
H. ovalisporium (Linder) Hol.-Jech. 1976,
H. pulchrum (Berk.) Hol.-Jech. 1976,
H. vesiculosum (Linder) Hol.-Jech. 1976

2. subsectio: Simplicia subsect. nov.
Typus: H. tomentosum (Pat.) Hol.-Jech. 1976

Conidiophora simplicia.
Conidiophores unbranched.

1 sp.: H. tomentosum (Pat.) Hol.-Jech. 1976
anamorph of Botryobasidium lembosporum (D.P.Rogers) Donk

5. sectio: Biformia sect. nov.
Typus: H. simile (Berk.) Hol.-Jech. 1976

Conidiophora biformia: breviora ramosa, subhyalina, tenuitunicata, numerosa; altiora simplicia, setiformia, fusca, crassitunicata, pauca.
Two different types of conidiophores present: shorter branched, subhyaline, thin-walled, numerous; longer unbranched, setiformis, fuscous, thick-walled, less frequent.

1 sp.: H. simile (Berk.) Hol.-Jech. 1976 anamorph of Botryobasidium simile Pouz. & Hol.-Jech.

Characters of the teleomorphs could not be used in the classification of Haplotrichum. Ten species of Botryobasidium found in connection with Haplotrichum anamorphs are very slightly differentiated morphologically and, as their characters are variable (especially the shape of basidiospores), the determination is very difficult and sometimes, without knowledge of the anamorph almost impossible.

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PHAEOHYPHOMYCOSIS IN A DOG CAUSED BY *PSEUDOMICRODOCHIUM SUTTONII* SP. NOV.

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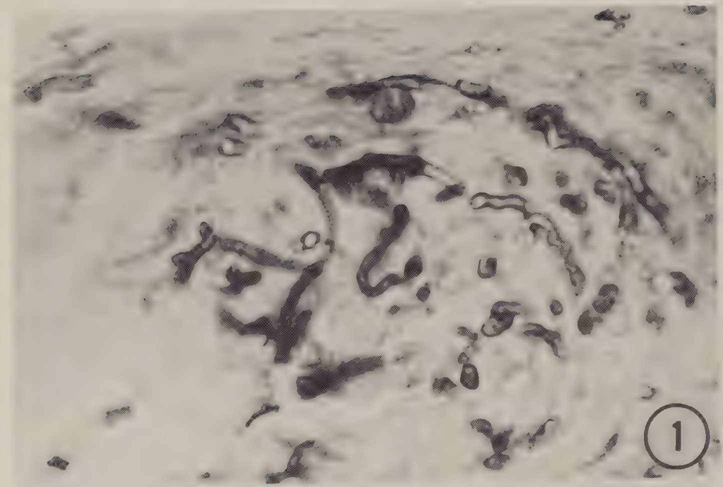
ABSTRACT

Pseudomicrodochium suttonii Ajello, Padhye et Payne, sp. nov., a new agent of phaeohyphomycosis, causing subcutaneous infection in a dog in Oklahoma is described.

INTRODUCTION

From an ear lesion in a dog, a dematiaceous mould was repeatedly isolated that was at first considered to be *Mycocentrospora acerina* (Hartig) Deighton. Histological sections prepared from the biopsy of infected tissue, when stained with the haemotoxylin and eosin stain and the periodic acid Schiff method, revealed dematiaceous hyphae and many bizarre fungal cells in the tissue (Fig. 1). The fungus was isolated in pure culture on Sabouraud dextrose agar containing chloramphenicol and cycloheximide. The culture was sent to Dr. B. C. Sutton of the Commonwealth Mycological Institute, Kew, Surrey, England, who found it to be more properly referable to the genus *Pseudomicrodochium* Sutton. Further studies of the isolate and comparison with written descriptions of the known species of *Pseudomicrodochium* led us to consider the canine isolate to be a new species of that genus.



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Colonies on Sabouraud dextrose agar were slow growing, mousy grey to black, moist, glistening at first and then becoming velvety and reaching 12-13 mm in diameter after 2 weeks at 25°C. Growth on potato dextrose agar was moderate, velvety, olive-grey, raised in the center with a dark black margin, and reaching 23-25 mm in diameter. Growth at 37°C was very slow, reached a diameter of only 5-6 mm after 2 weeks.

Microscopically, the immersed mycelium was sparse, composed of branched, septate, dematiaceous hyphae. Superficial mycelium was composed of branched, septate, dematiaceous hyphae, 1.5-2.0 µm wide. Conidiophores were absent. Conidiogenous cells were produced directly from the superficial vegetative mycelium (Fig. 3). They were solitary, enteroblastic, monophialidic, discrete, lateral, determinate, cylindrical to doliiform, smooth, with an indiscrete apical collarette, 3-4 µm long, 2-2.8 µm at the base, narrowing to 1-1.2 µm diameter at the apex (Figs. 3,4). Conidia were produced at the apices of phialides, pale brown to brown in color, 2-3 septate, smooth, straight to falcate, acicular, with apex and base being attenuated and pointed, and measuring 18-30 X 1-1.2 µm (Fig. 4).

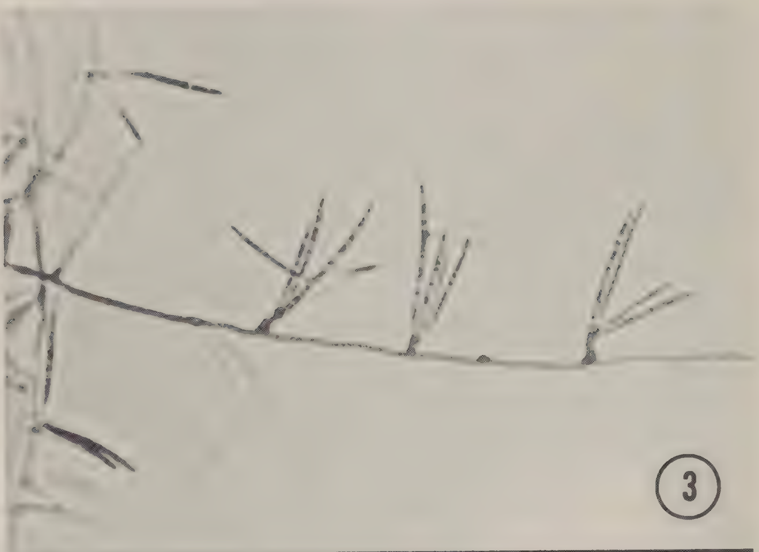
The isolate is described as a new species of *Pseudomicrodochium*, the first to be cultured on an artificial medium and is named in honor of Dr. B. C. Sutton who established the genus.

Pseudomicrodochium suttonii Ajello, Padhye et Payne, sp. nov.

Coloniae in agaro dextrose Sabouraudii tarde crescentes, pallide murinae (Ridgway Pl. Li, 15) usque intense olivaceo-griseae (Pl. Li, 23), mucidae, primum lucentes deinde velutinae, post hebdomades duas ad temperatum 25°C ad 12-13 mm attingentes; in agaro dextroso solani moderatim crescentes olivaceo-griseae (Pl. Li, 23b) ad

Fig. 1: Dematiaceous hyphae and cells of *P. suttonii* in tissue section from dog's ear, Periodic acid Schiff stain 650X

Fig. 2: Two-week-old colony of *P. suttonii* on Sabouraud dextrose agar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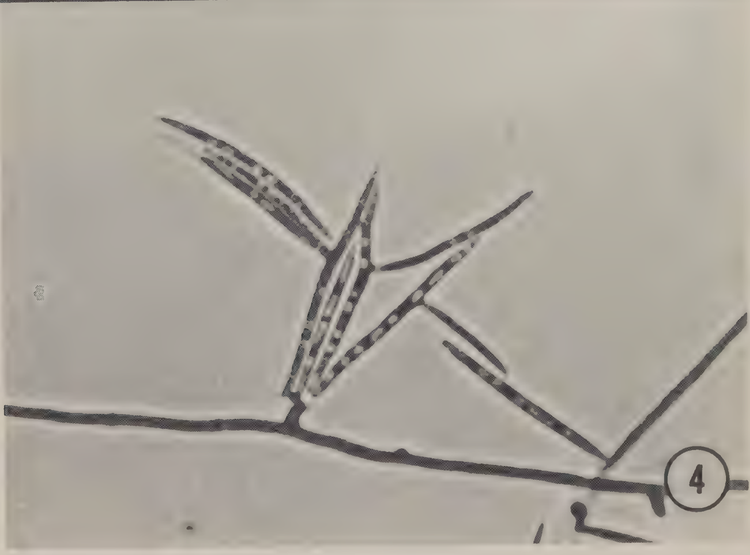
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centrum elevatae et intense olivaceo-griseo-marginatae, ad 23-25 mm in diam. attingentes; mycelium immersum sparsum, ex hyphis dematiaceis ramosis septatis, 1.5-2.0 µm latis compositum; conidiophora carentia; cellulae conidiogenae directe ex hyphia vegetativis superficialibus enata, solitariae enteroblasticae, monophialidicae, discretae, laterales, determinatae, cylindricae vel doliiformes, glabrae, collaretta indiscreta apicali 3-4 µm longa, ad basim 2-2.8 µm lata, ad apicem ad 1-1.2 µm attenuata praeditae; conidia ad apices phialidium enata, brunneola vel brunnea, 2-3-septata glabra, recta vel falcata, acicularia, utrinque attenuata et acuminata, 18-30 X 1-1.2 µm.

Typus: cultura siccata (B-2968)

A living culture of *P. suttonii* is deposited in the Commonwealth Mycological Institute, Kew, Surrey, England, with the accession number IMI 233463. A living culture is also maintained in the Mycology Division's culture collection, Center for Disease Control, Atlanta, Georgia, with the accession number B-2968.

DISCUSSION

Pseudomicrodochium suttonii differs from the three known species of *Pseudomicrodochium;* namely, *P. aciculare, P. cylindricum* (3), and *P. candidum* (1,2) in colonial and micromorphology. The *in vitro* colony of *P. suttonii* is dematiaceous (Fig.2), but those of *P. aciculare, P. cylindricum,* and *P. candidum* on their hosts are pale salmon to glistening white(1,3). The conidia of *P. cylindricum* are straight, cylindrical, hyaline, medianly 1-septate, 15-24 X 1.5-2.0 µm. Those of *P. candidum* are also straight, cylindrical, hyaline, 2-3 septate, and measure 15-18 X 2µm. The conidia of *P. aciculare* are hyaline, medianly 1-septate, rarely 2-septate, smooth, slightly curved, acicular, with apex and base attenuated,and pointed. They measure 21.5-31.5 X 1.0 µm. On the other hand, *P. suttonii* produces pale brown to brown, 2-3 septate, smooth, straight or falcate, acicular conidia which are attenuated and

Fig. 3: Solitary,lateral, cylindrical phialides and falcate to acicular conidia of *P. suttonii* 310X
Fig. 4: Pale brown, 2-3 septate, falcate to acicular conidia of *P. suttonii* 1280X

pointed at both ends and measure 18-30 X 1-1.2 µm (Figs. 3,4).

ACKNOWLEDGEMENT

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ON THE FAMILY TUBEUFIACEAE (PLEOSPORALES)

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SUMMARY

Ten genera are presently accepted in the family Tubeufiaceae. Those genera whose species are extralimital in distribution to temperate North America are considered briefly. *Rebentischia* and *Tubeufia*, with two and seven species respectively in temperate North America, are considered in more detail. *Tubeufia* is subdivided into the sections Tubeufia, Nectrioidea, Thaxteriella and Acanthostigmina; new combinations are proposed for *Tubeufia clintonii, T. pezizula,* and *T. scopula.*

INTRODUCTION

The family Tubeufiaceae was erected recently (Barr, 1979) to accommodate a number of pleosporaceous fungi that are typically either hypersaprobic on other fungi or on substrates previously colonized by other fungi or hyperparasitic on foliicolous fungi, or parasitic on scale insects, occasionally parasitic on living leaves. The ovoid, globose, ellipsoid or cylindric ascomata of species in the family are soft and fleshy in consistency, range in pigmentation from none (hyaline) to yellowish, brownish or pinkish to dark vinaceous brown, but not red; surfaces may be smooth or ornamented by protruding cells, hyphal appendages, or setae. The bitunicate asci are clavate or cylindric and develop from the base of the locule in narrow cellular pseudoparaphyses. Ascospores are hyaline, yellowish, or light vinaceous brown, narrowly oblong or nearly ellipsoid, short to elongate fusoid, or cylindric, and one or more commonly several septate. The conidial states known for a number of the species are hyphomycetous; sympoduloconidia are typically helicosporous or staurosporous, but dictyosporous conidia are associated in some taxa.

While fungi possessing these features have been accommodated within the Pleosporaceae ss. lat., in my opinion they form a well-defined family. Pirozynski (1977) suggested that *Tubeufia* could be grouped with *Acrospermum* in the Acrospermataceae and allied with *Cyanoderma* and *Oomyces*. The species of *Acrospermum* are not convincingly bitunicate, although Eriksson (1967) as well as Pirozynski (1977) believed that they were. Sherwood (1977), on the other hand, suggested that *Acrospermum* was more closely allied to members of the Clavicipitaceae. My interpretation of *Acrospermum* and its relatives would place the family in the Xylariales, although the taxa deviate in some respects from typical representatives of the order. The vertically elongate, light-colored ascomata of species of *Acrospermum* are superficially similar to the ovoid or cylindric ascomata of some species of *Tubeufia*. The locule in species of *Tubeufia* differs in the presence of attached pseudoparaphyses and relatively broadly oblong or cylindric, thick-walled asci with apical cytoplasmic protrusion from that in species of *Acrospermum* which contains paraphyses with free apical ends and narrowly cylindric asci with an evenly thickened apex. A transverse or oblique arrangement of peridial cells is seen in a number of fungi with vertically elongata ascomata, e.g., in species of *Acrospermum* (Eriksson, 1967), in species of *Tubeufia*, as in *T. paludosa* and *T. cylindrothecia* (see later), in the elongate beak of *Ophioceras dolichosporum* (Berk. & Curt.) Sacc. (Conway and Barr, 1977). Such an arrangement of peridium cells seems to be for support, an architectural device arrived at by some Ascomycetes that have developed similarly elongate ascomata or beaks. The diagnostic features of the centrum or locule differ in each of these taxa.

Many of the taxa of the Tubeufiaceae are tropical or otherwise extralimital in distribution. In this study the genera that I presently treat in the family are discussed. The species now known to occur in temperate North America receive a more detailed consideration. At least one additional genus probably belongs in the family, composed of species parasitic on rust sori, whose elongate ascospores are spirally twisted in the ascus (Rossman, 1977).

GENERA AND SPECIES

ALLONECTE H. Sydow, Ann. Mycol. 37: 378. 1939.

Allonecte lagerheimii (Pat.) Sydow, the sole species, is a leaf parasite known from Ecuador, whose reddish-brown ascomata penetrate the leaf epidermis by a basal foot. The peridium bears hyphal appendages and the ellipsoid ascospores are one septate (Müller and von Arx, 1962; Rossman, 1979).

BOERLAGIOMYCES Butzin, Willdenowia 8: 39. 1977.

Boerlagella Penzig & Sacc. Malpighia 11: 404. 1897, non Pierre ex Boerlage, 1891 (Sapotaceae).

Von Arx and Müller (1975) observed that the genus was closely related to *Tubeufia*. The type species, *B. velutinus* (Penzig & Sacc.) Butzin, and second species, *B. laxus* (Penzig & Sacc.) Butzin, were both described from Java on decaying wood or culms. *Boerlagiomyces laxus* may be an immature stage of *B. velutinus*. This species has dark brown, soft-walled ascomata that bear hyphal appendages and are seated in a well-developed dark subiculum. The ascospores are hyaline, elongate, narrowly clavate, and multiseptate with vertical septa in a number of the cells. *Boerlagella indica* Tilak et al. (Sydowia 24: 294. 1971) may belong in *Berlesiella* or *Dictyotrichiella* according to the description. The description and illustration of *Thaxteriellopsis lignicola* Sivanesan et al. (Kavaka 4: 39. 1976) are suggestive of *Boerlagiomyces*.

BYSSOCALLIS H. Sydow, Ann. Mycol. 25: 14. 1927.

Petrak (1931) and Pirozynski (1977) included the species of *Byssocallis* in *Puttemansia* but Rossman (1979) retained the two genera separately. Ascospores in the species of *Byssocallis* may have apiculate ends as in species of *Puttemansia* or blunt ends as in species of *Melioliphila*. Ascomata develop on meliolaceous hosts. Rossman (1979) suggested that *Byssocallis* is closely related to *Melioliphila* because of the similarity of ascospore shapes as well as the presence of an associated *Eriomycopsis* conidial state with *B. capensis* (Doidge) Rossman. The type species is *B. phoebes* H. Sydow.

LETENDRAEA Sacc. Michelia 2: 73. 1880.

Species with one-septate ascospores, thin-walled pallid ascomata and not known to possess a conidial state are placed in *Letendraea*. *Letendraea helminthicola* (Berk. & Br.) Weese ex Petch (Trans. Brit. Mycol. Soc. 21: 277. 1938), the type species, is European and not yet known from North America. Müller and von Arx (1962) and Samuels (1973) provided descriptions and illustrations of this species. *Letendraea padouk* Nicot & Parguey-Leduc (Compt. Rend. Hebd. Seances Acad. Sci. 248: 1560. 1959) is a similar but larger species from Africa. Some species described in the genus do not belong here: *L. luteola* Ell. & Ev. and *L. rhynchostoma* von Höhnel are species of *Cryptosphaeria*, *L. rickiana* Rehm is a species of *Nectria*, and *L. lasiosphaerioides* Teng is a species of *Didymotrichia*. According to descriptions, other species described in *Letendraea* are also to be removed from the genus, but I have not studied these and cannot suggest their true position at this time.

MELIOLIPHILA Speg. Bol. Acad. Ci. Cordoba 26: 344. 1924 (1923).

The species of this genus have thick-walled, opaque ascomata, clavate, blunt-ended, several-septate ascospores and associated conidial states belonging to *Eriomycopsis* Speg. They are hyperparasitic on meliolaceous taxa in tropical regions. Pirozynski (1977) redescribed the genus and illustrated several species. Rossman (1979) added other species to the genus and clarified synonymy of the type species, *Calonectria graminicola* Speg. non (Berk. & Br.) Wollenw. The earliest name for the type species is *M. volutella* (Berk. & Br.) Rossman (Mycotaxon 8: 551. 1979).

PARANECTRIELLA (P. Henn. ex Sacc.) von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 119: 899. 1910.

Another tropical genus of hyperparasitic fungi, *Paranectriella* differs from *Melioliphila* in small, pallid, thin-walled, translucent ascomata, appendaged ascospores, and in the *Titaea* conidial state. Pirozynski (1977) redescribed the genus and provided illustrations. Hawksworth and Pirozynski (1977) corrected citation and synonymy of the generic name, typified by *P. juruana* (P. Henn.) Piroz. (Kew Bull. 31: 598. 1977).

PODONECTRIA Petch, Trans. Brit. Mycol. Soc. 7: 146. 1921.

Species with pallid or brightly pigmented ascomata, with granular brown outer coating in some, elongate-clavate multiseptate ascospores, parasitic on scale insects, with *Tetracrium* conidial states belong in *Podonectria*. Only the type species, *P. coccicola* (Ell. & Ev.) Petch, has been collected in southern regions of temperate North America (Florida, Mississippi, Louisiana, Texas) as well as in tropical regions. Rossman (1978) monographed the genus, and described and illustrated eight species worldwide.

PUTTEMANSIA P. Henn. Hedwigia 41: 113. 1902.

The ascomata of the species of *Puttemansia* are thick walled and opaque, and are surrounded by straight or flexuous hyphal appendages. The ascospores are several septate, fusoid or clavate with apiculate or rostrate ends. Conidial states are described (Pirozynski, 1977) as species of *Titaea* Sacc. or *Guelichia* Speg. (and possibly *Spermatoloncha* Speg.) Rossman (1979) noted the association of *Tetracrium* conidia with ascocarps on lectotype material of *P. lanosa* P. Henn., the type species. Petrak (1931) first recognized that species of *Puttemansia* were not members of the Hypocreales but were "hypocreoide Dothidaceen." Pirozynski (1977) included *Annajenkinsia* Thirum. & Narasimhan (Mycologia 47: 760. 1955) as a synonym of *Puttemansia*, whereas von Arx and Müller (1975) regarded *Annajenkinsia* as a member of the Patellariaceae. According to description and illustration of *A. fungicola* Thirum. & Narasimhan, the species belongs in *Puttemansia*. Petrak (1931) and Pirozynski (1977) included the species of *Byssocallis* in *Puttemansia* but Rossman (1979) retained two separate genera.

REBENTISCHIA Karsten, Fungi Fenniae Exsiccati No. 881 (in sched.) 1869; Mycol. Fenn. 2: 14. 1873.

Ascomata at first immersed in loose outer layers of periderm or cortex of host, remaining immersed or becoming erumpent superficial, separate or few grouped, globose, somewhat depressed, or ovoid, often collabent in age, apex blunt; peridium soft and fleshy, composed of pseudoparenchymatous cells, light to dark vinaceous brown externally, toward interior of narrow compressed layers of hyaline or vinaceous-tinged cells, pigment encrusted on surface of outermost cells; surface often roughened by protruding cells or short hyphae; subiculum hyphae sparse. Asci from base of locule, bitunicate, oblong clavate, octosporous or occasionally only four maturing; pseudoparaphyses narrow cellular, occupying apical pore region. Ascospores hyaline at first, becoming light dull brown or light vinaceous brown, narrowly clavate, usually slightly curved, apex rounded, tapered to base, several septate, primary septum near base, basal cell remaining hyaline, becoming elongate and setiform, secondary septa formed in upper region, mid cells more strongly pigmented than upper cell, cells uniglobulate, wall smooth, overlapping biseriate in the ascus.

Conidial state not known with certainty. Short denticulate conidiogenous cells have been observed attached to the lower peridium or to associated light brown hyphae near base of ascomata. One collection of *R. massalongii* (Barr 6714) in culture formed small, dark brown pycnidia, 110-165 μm diam. Conidia were hyaline, ellipsoid, 5 x 2.5 μm, and were produced from small hyaline cells that lined the cavity. This seems to be an *Asteromella* spermatial state.

On woody or suffrutescent stems and branches, at times around old, partially healed cankers.

Type species: *Rebentischia pomiformis* Karst. = *R. massalongii* (Mont.) Sacc.

Von Arx and Müller (1975) synonymized *R. pomiformis* with *R. massalongii*, the earlier name, as Saccardo (1877) had suggested. A number of species have been described in the genus, although there appear to be only two valid entities, quite similar to one another, but differing in habitat and in size ranges. These may be recognized by the following characters, essentially those used by Berlese (1894, pl. XVIII, figs. 4, 5):

1. On suffrutescent stems of shrubs and vines; main body of ascospore 17-25(-30) x 4-6(-7.5) μm.........*R. unicaudata*
1. On woody branches of trees; main body of ascospore (22-) 28-38(-40) x 6-9(-10) μm...................*R. massalongii*

Müller (1950) recorded both *R. massalongii* and *R. unicaudata*, as well as *R. typhae*, from Switzerland. *Rebentischia typhae* H. Fabre (Ann. Sci. Nat. Bot., Ser. VI, 9: 88. 1878) has been removed from the genus to *Buergenerula* by von Arx (1977). Those specimens labelled *R. typhae* that I examined, e.g., Rehm Ascomyceten 1137 (NY), bore only a large variant of *Lophiostoma dacryosporum* H. Fabre, with dark brown five-(six-)septate ascospores that taper to the pallid basal cell. *Rebentischia ulmicola* Fautr. & Lamb. (Rev. Mycol. 54. 1897) (In Saccardo and Sydow, 1899) is probably identical with *R. massalongii*, and *R. thujana* Feltgen (Vorstud. Pilz. Luxemb., Nachtr. 3: 223. 1903) appears to be the same according to the description. Saccardo (1883) included *R. ranella* (Berk. & Rav.) Sacc. in his synopsis of species of *Rebentischia*. Ellis and Everhart (1892) entered this name under *Rosellinia rattus* (Schw.) Ell. & Ev., but observed that the generic position was uncertain. Although I have seen no specimens, the description of *Sphaeria ranella* Berk. & Rav. does not suggest a species of *Rebentischia*. Other species described in *Rebentischia* have not been studied, i.e., *R. taurica* Naoumov & Dobr. (Mat. Mycol. Phytopathol. Leningrad 8(2): 136. 1929), *R. brevicaudata* Guyot (Ann. Serv. Bot. Tunis. 28: 132. (1955) 1958), and *R. costi* Bat. et al. in Batista & Bezzera (Publ. Inst. Micol. Univ. Recife 385: 7. 1963). Both *R. anodendri* Tilak & R. Rao (Sydowia 21: 308. (1967) 1968) and *R. elaeodendri* Tilak & Srin. (Sydowia 24: 95. (1970) 1971) were described with muriform ascospores and do not belong in *Rebentischia*.

Rebentischia massalongii (Mont.) Sacc. Nuovo Giorn. Bot. Ital. 8: 12. 1876. Figs. 1, 2

Sphaeria massalongii Mont. Syll. Gen. Sp. Crypt. p. 237. 1856.
Rebentischia pomiformis Karst. Fungi Fenniae Exsiccati No. 881. 1869; Mycol. Fenn. 2: 97. 1873.

Ascomata globose or slightly depressed, erumpent superficial at maturity, collabent on drying, (220-)300-440(-495) µm diam, black under low magnification; peridium soft, composed of several layers of pseudoparenchymatous cells, variable in width, (10-)24-35 µm wide; surface roughened with protruding cells or short hyphae, vinaceous brown pigment encrusted on outer layers of cells. Asci 82-120 x 15-22 µm, clavate; pseudoparaphyses narrow cellular, 1.5-2.5 µm wide. Ascospores (22-)28-38(-40) x 6-9 µm, at maturity 4-(5-)septate in narrowly obovoid main body, hyaline basal cell and setiform base 7-24 µm long, cell 3.5-4.5 µm wide, tapered to 1-1.5 µm wide, apical cell hyaline or faintly pigmented, mid cells light clear vinaceous brown, contents multiguttulate young, with one or two globules per cell at maturity, wall smooth.

On woody branches or trunks, often surrounding old cankers. Europe and North America.

Material examined: EUROPE: AUSTRIA: *Salix* sp., Herb. F. v. Höhnel, Sonntagsberg, leg. Strasser; Langenschönbichl l. Tulln, 3 Jun 1905, leg. von Höhnel (both FH). FINLAND: *Acer platanoides* L., P. A. Karsten, Finland Fungi 881 (NY, part of type of *R. pomiformis*, sparse and overmature). NORTH AMERICA: USA: Maine: *Acer pensylvanicum* L., Barr 3266, 3268; *Abies balsamea* (L.) Mill., Barr 3214A, 3428 (MASS); Massachusetts: *Ulmus americana* L., Barr 6507 (MASS); *Ilex verticillata* (L.) Gray, Barr 6633 (MASS); *Robinia pseudo-acacia* L., Barr 6714 (MASS).

Rebentischia unicaudata (Berk. & Br.) Sacc. Atti Soc. Veneto-Trentini Sci. Nat. 4: 88. 1875; Syll. Fung. 2: 12. 1883. Fig. 3

Sphaeria unicaudata Berk. & Br. Ann. Mag. Nat. Hist. ser. 3, 3: 18 (373). 1859.

Ascomata globose, depressed or ovoid, often remaining partially immersed, (100-)220-330(-440) μm diam, black under low magnification; peridium soft, composed of few or several layers of pseudoparenchymatous cells, (10-)20-30 μm wide; surface roughened by protruding cells or smooth, vinaceous brown pigment encrusted on outer layers of cells. Asci (40-)60-100 x (10-)12-15(-18) μm, clavate; pseudoparaphyses narrow cellular, 1.5-2 μm wide. Ascospores 17-25(-30) x 4-6(-7.5) μm, at maturity 4-septate in narrowly obovoid main body, hyaline basal cell and setiform base 4-15 μm long, cell 4 μm wide, tapered to 1-1.5 μm wide, apical cell hyaline, mid cells light vinaceous brown, contents multiguttulate young, one or two globules per cell at maturity, wall smooth.

On suffrutescent stems and branches of shrubs and vines. Europe and North America.

Material examined: EUROPE: AUSTRIA: *Clematis*, Weese, Eumycetes sel. exs. 542 (BPI); Krypt. exs. 1921 (BPI, NY); Graz, leg. G. de Niessl (BPI); Rehm Ascomyceten 241b (FH); *Berberis* sp., Herb. F. v. Höhnel, Tumpen, Ötzthal, Tirol (FH). FINLAND: *Ribes alpinum* L., Barr 5675 (MASS). FRANCE: *Clematis*, Roumeguere, Fungi sel. exs. 4857 (NY); *Sambucus nigra* L., Roumeguere, Fungi sel. exs. 6186 (NY). HUNGARY: *Clematis*, Rehm Ascomyceten 241 (NY). SWITZERLAND: *Clematis vitalba* L., Kt. Wallis, St. Gingolph, 7 May 1962, leg. E. Müller (BPI); "15", Frauenfeld (NY). YUGOSLAVIA: *Clematis*, Fungi montenegrini, St. Monasserium, Pira, 24 Aug 1904, leg. F. Bubák (BPI). NORTH AMERICA: USA:

Massachusetts: *Rubus* sp., Barr 6224 (MASS).

TUBEUFIA Penzig & Sacc. Malpighia 11: 517. 1897.

Acanthostigmina von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 118: 1499. 1909.
Thaxteriella Petrak, Ann. Mycol. 22: 63. 1924.

Ascomata superficial, separate or grouped, in thin or well-developed subiculum, cylindric, ovoid or globose, in some species collabent on drying, small to medium sized, pallid, light or brightly colored or dull brownish, grayish, black or vinaceous, apex bluntly papillate, surface glabrous or pulverulent with protruding cells or short setose or bearing hyphal appendages; peridium soft and fleshy, composed of pseudoparenchymatous cells, external region hyaline, light colored, reddish brown or vinaceous brown, with pigment encrusted on surface usually, and internal region hyaline, cells more compressed, thickened at upper sides around apex. Asci from base of locule, bitunicate, oblong or clavate, usually octosporous; pseudoparaphyses narrow cellular. Ascospores hyaline, light yellowish or light brownish after discharge, elongate fusoid or clavate, inequilateral often slightly curved, several septate, not usually constricted at septa, contents guttulate becoming homogeneous and refractive in age, wall smooth, overlapping bi- or triseriate or in fascicles in the ascus. Conidial states often species of *Helicosporium* or *Helicoma*; conidiophores ± setiform, arising from superficial hyphae, conidiogenous cells denticulate, as sympodially proliferating lateral pegs; conidia hyaline or light yellowish brown, hooked or helicosporous, (one celled) several septate. Additionally, a *Monodictys* state is known for *T. amazonensis*: conidiogenous cells as lateral branches of hyphae, forming stalk cell and single conidium; conidia dark brown, elongate or irregular in shape, muriform. Samuels et al. (1979) also described an *Asteromella*-like state obtained in culture for this species. Hughes (1978) illustrated features of a species of *Tubeufia* associated with *Pendulispora venezuelanica* M. B. Ellis, a fungus that has coiled conidium initials that develop into muriform pigmented conidia.

Hypersaprobic, on decaying woody or herbaceous substrates often over old ascomata or mycelium of other ascomycetes, in tropical and temperate regions.

Type species (lectotype): *T. javanica* Penzig & Sacc. = *T. paludosa* (Crouan & Crouan) Rossman.

Tubeufia was erected (Penzig and Saccardo, 1897) to accommodate three species from Java: *T. javanica*, *T. coronata* and *T. anceps*, all with vertically elongate, fleshy, white or pallid ascomata and elongate fusoid ascospores. In 1909a von Höhnel described *T. helicomyces* and transferred *Ophionectria cylindrothecia* Seaver to *Tubeufia*. Seaver (1909) included *O. cylindrothecia* and *O. cerea* in his concept of *Ophionectria*. Von Höhnel (1919) discussed and distinguished a number of taxa with characters somewhat similar to those of *Tubeufia*. He separated *Ophionectria*, based on *O. trichospora* (Berk. & Br.) Sacc., from *Tubeufia*, removed *T. anceps* to *Ophionectria*, and added *T. cerea* (Berk. & Curt.) von Höhnel to *Tubeufia*, selecting *T. javanica* Penzig & Sacc. as the lectotype species. Later studies by Booth (1964) and Rossman (1977) confirmed that *O. trichospora* is a hypocreaceous fungus.

Webster (1951) demonstrated in culture the connection between *T. helicomyces* and the associated *Helicosporium* state. Booth (1964) emended the concept of *Tubeufia*, recognizing variability in shape of ascomata, as well as the occurrence in some species of short hyphal setae on the peridium. He described the *Helicosporium* states of *T. cerea* and his new species *T. rugosa*. In *Tubeufia* Booth included species with cylindric to ellipsoid ascomata -- *T. javanica*, *T. coronata*, *T. anceps*, *T. cylindrothecia*, and *T. nigrotuberculata* Hino & Katumoto, and species with ovoid to doliform ascomata -- *T. cerea*, *T. helicomyces*, and *T. rugosa*. Booth excluded *T. asclepiadis* Bat. & Garnier (Mem. Soc. Broteriana 14: 67-69. 1961) because the species has unitunicate asci and nonseptate ascospores; according to Rossman (1979) this name is a synonym of *Saccardomyces socius* P. Henn. Pirozynski (1972) transferred *T. nigrotuberculata* to *Herpotrichia*. *Tubeufia minuta* Munk (Bot. Not. 119: 179. 1966) has much tapered small ascospores, small ascomata, and perhaps is better disposed in *Herpotrichiella* (Rossman, pers. comm.). *Tubeufia corynespora* Munk (Bot. Not. 119: 189. 1966), described from Denmark and also known from West Germany (Hilber and Hilber, 1978) has dark ascomata and ascospores 50-65 x 3.5-4 µm. The species would fit in section Thaxteriella. *Tubeufia acaciae* Tilak & Kale (Sydowia 23: 11. (1969) 1970) from India has violet to red, setose or appendaged ascomata. Pirozynski (1972) described and illustrated both conidial and ascosporic states of *T. helicoma* (Phil. & Plowr.) Piroz., the older epithet for *T. rugosa*. Pirozynski also provided details on the morphology and conidial state of *Thaxteriella pezizula* (Berk. & Curt.) Petrak.

Petrak (1924) erected *Thaxteriella* for *T. corticola*, collected in Puerto Rico. Later (Petrak, 1953) he made the combination *T. pezizula*, and remarked that this species, widespread in southeastern USA, was probably identical with *T. corticola*. Pirozynski (1972) examined the part of *T. corticola* in Herb. IMI, found it to be in poor condition, but noted that it seemed to be the same as *T. pezizula*. According to the original description of *T. corticola*, it could well be a collection of *T. pezizula*. *Thaxteriella* has been separated from *Tubeufia* on the bases of dark-colored, globose, collabent ascomata seated in a well-developed subiculum versus light-colored, cylindric, ovoid or globose ascomata in a slight subiculum, and on variations in the conidial states. When the species of *Tubeufia* were compiled and compared with *Thaxteriella pezizula*, it became evident that differences between *T. pezizula* and *Tubeufia helicoma* were not of greater magnitude than those between *T. helicoma* and *T. paludosa* or *T. helicoma* and *T. cerea*. Separation of both *T. helicoma* and *T. paludosa* into *Thaxteriella* was contemplated, but the relationship between these and species of *Tubeufia* seems better expressed by arranging them in several sections within one genus. While this manuscript was in preparation, accounts of *Thaxteriella roraimensis* Samuels & Müller (1979) and three species of *Tubeufia* (Samuels et al., 1979) appeared; the discussion of these species further convinced me that the arrangement proposed here is preferable given our present knowledge of these fungi.

In 1909b, von Höhnel erected *Acanthostigmina* for *Lasiosphaeria minuta* Fuckel. He compared this species with *Acanthostigma nectrioideum* Penzig & Sacc., a species with globose-ovoid ascomata and soft brown peridium ornamented with dark setae around the apex. He decided these two were identical and made the combination *A. minuta* (Fckl.) von Höhnel. My study of specimens and slides from the Höhnel Herbarium (FH) shows that they are indeed identical, and also that North American specimens of *Acanthostigma clintonii* (Peck) Sacc. belong to the same taxon. Von Arx and Müller (1975) considered *Acanthostigmina* to be synonymous with *Tubeufia* and I agree. On the other hand, I consider that *Acanthostigmella* von Höhnel with the type species *A. genuflexa* is different from *Tubeufia* and belongs in the Herpotrichiellaceae of the Chaetothyriales (Barr, 1977).

Rossman (1977) disposed of some of the species excluded from *Ophionectria*, and provided expanded synonymy for *T. cerea* and *T. paludosa*, with the latter the earliest epithet for the type species. Additional information on a number of tropical species was provided by Rossman (1979), with transfers of species from *Calonectria*, and by Samuels et al. (1979) and Samuels and Müller (1979).

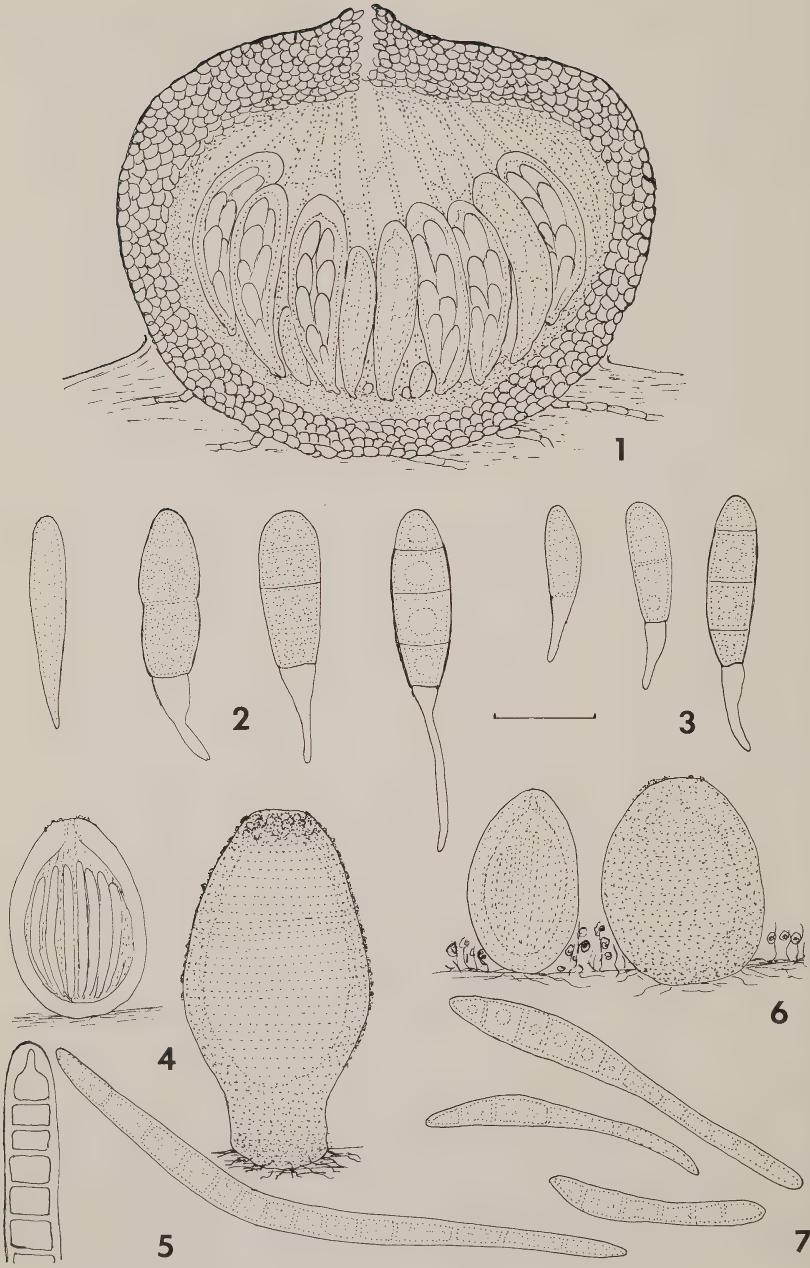
The conidial states associated with several species of *Tubeufia* are striking: often a brightly pigmented -- yellow green, olive green or bright brown -- turf of erect setiform conidiophores arises from decumbent hyphae; the conidiophores bear coiled conidia from either lateral or terminal conidiogenous cells. Linder's (1929) superb renderings of helicosporous Fungi Imperfecti include two species that he recognized with ascosporic states, *Helicosporium nematosporum* Linder with *Lasiosphaeria nematospora* Linder (= *Tubeufia helicoma*) and *Helicoma curtisii* Berk. with *Lasiosphaeria pezizula*, in addition to several species later linked with species of *Tubeufia*. Von Höhnel (1909a) noted a *Helicosporium* conidial state with *T. helicomyces* and Webster (1951) made the cultural connection of *T. helicomyces* with *Helicosporium phragmitis* von Höhnel. Hughes (1958) recognized *Helicoma muelleri* Corda, the type species of *Helicoma*, as a state of *Lasiosphaeria pezizula*, and *Helicosporium vegetum* Nees, the type species of *Helicosporium*, as a state of *Ophionectria cerea*. Booth (1964) described both the *H. vegetum* state of *T. cerea* from natural association and from culture and the *Helicosporium* state of *T. rugosa*. Pirozynski (1972) provided detailed accounts of some variations in conidial states and distinguished between *Helicoma muelleri* conidial state of *Thaxteriella pezizula*, and *Helicosporium pannosum* (Berk. & Curt.) R. T. Moore conidial state of *Tubeufia helicoma*. In *Helicoma muelleri* the conidium develops from a terminal conical denticle or two or three from sympodial succession of the terminal denticle, whereas in *Helicosporium pannosum* and other species of *Helicosporium*, the conidia develop from sympodially proliferating pegs lateral on setiform conidiophores.

The picture is not that clear, however. Many collections of species of *Tubeufia* bear associated conidial fungi that are neither *Helicoma* nor *Helicosporium*. Hughes (1978) reported a New Zealand species of *Tubeufia* associated with conidiophores and dictyosporous conidia of *Pendulispora venezuelanica* M. B. Ellis. Samuels et al. (1979) described and discussed in some detail tropical collections of *Tubeufia* *amazonensis* from which developed a *Monodictys*-like conidial state, and a *Helicomyces*-like, unicellular, hooked rather than coiled conidial state for *Tubeufia palmarum*. Certainly additional studies of collections of *Tubeufia* are required to determine not only variations in conidial states but also the limits of species. The following key to sections and species of *Tubeufia* known in temperate North America outlines my concepts from a study of temperate and some tropical material, as well as information from the literature.

1. Ascomata ellipsoid or cylindric, whitish, pallid or brightly pigmented, blackening on drying; peridium ornamentation when present of hyphae or protruding cells, rarely short setae.............Sect. Tubeufia..2
1. Ascomata globose or ovoid.............................3
   2. Ascospores 40-55(-65) x 3-5 µm, (6-)7-9-(13-)septate. *T. cylindrothecia*
   2. Ascospores (70-)100-200(-230) x (2-)3.5-7(-8) µm, up to 35-septate.........................*T. paludosa*
3. Ascomata brightly pigmented due to external granules; peridium ornamentation when present of hyphae or protruding cells.......................Sect. Nectrioidea One temperate zone species; ascospores (27-)30-52 x 2.5-3.5(-4.5) µm, 7-10-(13-)septate............*T. cerea*
3. Ascomata vinaceous, grayish or blackish brown pigmented.4
   4. Peridium ornamentation when present of hyphae or protruding cells................Sect. Thaxteriella..5
   4. Peridium ornamentation of dark, thick-walled, tapering setae, rarely reduced to dark protruding cells.......................Sect. Acanthostigmina..6
5. Ascospores (25-)35-60(-65) x (6.5-)8-12(-13) µm, (5-)7-9-(11-)septate.........................*T. pezizula*
5. Ascospores (52-)60-100(-130) x 4-6.5(-8) µm, up to 25-septate...................................*T. helicoma*
   6. Ascospores (19-)32-45(-54) x (2.5-)3.5-5.5(-6) µm, 7-septate.................................*T. clintonii*
   6. Ascospores (40-)56-80(-125) x (2-)2.5-3.5(-4.5) µm, 11-septate................................*T. scopula*

Tubeufia sect. Tubeufia

Ascomata ellipsoid or cylindric, hyaline, white, yellowish pinkish or becoming darkened or black at maturity and on drying; peridium smooth or ornamented at apex with protruding cells or short to elongate thick-walled hyphal appendages, rarely with setae, inner region never pigmented, surface cells horizontally elongate.



Type species: *T. paludosa.*

In addition to *T. paludosa* and *T. cylindrothecia*, regarded as variants of one species by Rossman (1977), *T. helicomyces*, *T. pachythrix* (Rehm) Rossman, *T. stromaticola* (P. Henn.) Rossman, and the species briefly described by Hughes (1978) and associated with *Pendulispora venezuelanica*, belong in the section. The first three species are linked with *Helicosporium* conidial states (but see discussion).

Tubeufia paludosa (Crouan & Crouan) Rossman, Mycologia 69: 383. 1977. Figs. 4, 5

Nectria paludosa Crouan & Crouan, Florule du Finistere, p. 38. 1867.
Ophionectria paludosa (Crouan & Crouan) Sacc. Michelia 1: 323. 1878.
Tubeufia javanica Penzig & Sacc. Malpighia 11: 517. 1897.
Tubeufia coronata Penzig & Sacc. Malpighia 11: 517. 1897.

Ascomata vertically elongate, ellipsoid or cylindric, 165-300 µm diam, 245-330(-550) µm high, light yellowish becoming dull grayish translucent or dull brown, blackened at base; peridium soft, several layers of pseudoparenchymatous cells, 15-18 µm wide; surface glabrous, rugose with protruding cells or bearing short or elongate thick-walled, hyphal appendages, up to 45-115 µm long, 2-4 µm wide, surface cells often in horizontal rows, pigment encrusted on surface in patches. Asci (80-)140-195(-280) x 10-13(-25) µm, elongate cylindric; pseudoparaphyses narrow cellular. Ascospores elongate clavate, (70-)100-200(-230) x (2-)3.5-7(-8) µm, hyaline, pale yellowish or pinkish, often curved, up to

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Figs. 1, 2. *Rebentischia massalongii*: 1. Ascoma in section (Barr 3266). 2. Stages in maturation of ascospores (Barr 6507). Fig. 3. *R. unicaudata*, stages in maturation of ascospores (Rehm Ascom. 241b). Figs. 4, 5. *Tubeufia paludosa*: 4. Outline of ascoma in section (Dumont PA 1709) and surface view (isolectotype of *T. javanica*) showing aspect of horizontally arranged cells and protruding pigment-encursted cells. 5. Maturing ascospore (Thaxter, Florida) and tip of mature ascospore (Dumont PA 1709). Figs. 6, 7. *T. cylindrothecia*: 6. Outline of ascomata in turf of conidiophores and conidia (Fungi of Bermuda 67). 7. Three ascospores, variation in shape and septation (Dumont CO 1725). Standard line = 60 µm for Fig. 1; 15 µm for Figs. 2, 3, 5, 7; 150 µm for Figs. 4, 6.

35-septate, not constricted at septa, cells containing numerous guttules or homogeneous, wall smooth, often thickened over tips.

On woody substrates or large monocots such as bamboo or palm, often over stromata of other ascomycetes.

Material examined: USA: Massachusetts: Barr 2839a (MASS); Florida: Coconut Grove, R. Thaxter (2 collections, FH). PANAMA: Dumont PA 1838, 1709, 1907 (NY). COLOMBIA: Dumont CO 247 (NY). VENEZUELA: Dumont VE 2993, 3139, 2426, 2577, 2657, 3147, 3974, 5052, 5258, 6462, 6644, 6955 (NY). JAVA: Tjibodas, 5.2.1897, Penzig (Höhnel Herb., FH; isolectotype of *T. javanica*).

Some of these collections grouped under *T. paludosa* may be separated eventually: Samuels et al. (1979) restrict *T. paludosa* to specimens with helicosporous conidia, and note that Dumont PA 1838 had associated *Monodictys*-like conidia and that a collection from New Zealand produced a *Monodictys*-like state. Dumont PA 1838, macroscopically similar to other collections of *T. paludosa*, is considerably larger and has differently shaped ascomata than *T. amazonensis* Samuels et al. (1979) which also has a *Monodictys*-like state. Dumont VE-3147 was associated with *Pendulispora venezuelanica*, and could be identical with the collection described from New Zealand by Hughes (1978).

Rossman's (1977) concept of *T. paludosa* encompasses material with shorter ascospores that I separate as *T. cylindrothecia*, as well as the narrow-spored *T. helicomyces* not yet seen from North America. Her synonymy for *T. paludosa* also includes *T. anceps* Penzig & Sacc. (*Ophionectria anceps* (Penzig & Sacc.) von Höhnel). The ascospores were described as 35-42 x 4-5 µm, but the asci were said to be aparaphysate in contrast to those of *T. javanica* and *T. coronata* described at the same time. Rossman (1979) reduced *Calonectria effugiens* Penzig & Sacc. (Malpighia 11: 515. 1897) to synonymy under *T. paludosa*. The ascospores are in the size range of *T. cylindrothecia*, 45-69 x 4.5-5 µm, but she noted that *Alternaria*- and *Acrodictys*-like conidia were associated, so this entity too may represent a separate species.

Tubeufia cylindrothecia (Seaver) von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 68: 1479. 1909. Figs. 6, 7

Ophionectria cylindrothecia Seaver, Mycologia 1: 70. 1909.

Ascomata vertically elongate, ellipsoid or elongate ovoid, (135-)165-275(-355) μm diam, (220-)275-385(-440) μm high, pale yellowish, creamy, grayish, or light translucent brownish, darkened at base; peridium soft, several layers of pseudoparenchymatous cells, 15-20 μm wide; surface glabrous or rugose with projecting cells or short setae at apex, pigment encrusted in patches on surface, surface cells often in horizontal rows. Asci (50-)85-140 x 9-15 μm, cylindric clavate; pseudoparaphyses narrow cellular. Ascospores elongate clavate or fusoid, tapering to ends, 40-55(-65) x (2.5-)3-5 μm, often bent or curved, (5-)7-9-(13-)septate, not constricted at septa, contents with numerous guttules or one globule per cell, wall smooth.

Conidial state: *Helicosporium roseum*: Turf white or pinkish, composed of upright setiform conidiophores arising from recumbent hyphae, bearing conidiogenous cells laterally; conidial coils 30-45 μm diam, cells 2-4.5(-5.5) μm wide, several septate.

On old wood or monocot culms and leaves, often over overmature ascomycetes.

Material examined: USA: Massachusetts: Waverly, 12 Oct 1899, R. Thaxter (FH); Texas: Big Thicket Scenic Area, near Coldspring, San Jacinto Co., 26 Aug 1967, C. T. Rogerson (NY). BERMUDA: Seaver and Waterston, Fungi of Bermuda 61B, 67A, 67C, 83, 406, 408, 410C (NY); B. & J. Dodge, Aug 1911 (NY); Paget Marsh, 16 Jan 22, H. H. Whetzel (NY), same data as Bermuda Fungi (BPI). TRINIDAD: Maraval Valley, Port of Spain, 1912-13, R. Thaxter (FH); Emperor Valley, Port of Spain, 1912-13, R. Thaxter (FH). PANAMA: Valley of upper Rio Chirique Viejo, prov. Chiriqui, 1 Jul 1935, G. W. Martin (BPI, as *T. margarita* ined.). COLOMBIA: Dumont CO 1725, 1998 (NY). VENEZUELA: Dumont VE 2695 (NY).

Ophionectria cylindrothecia was described from Ohio on old corn stalks (Seaver, 1909) but I have not located the collection. Other collections determined by Seaver as this species were those from Bermuda. The collection from Texas is only tentatively assigned to *T. cylindrothecia*. Rogerson obtained the conidial state in culture, noted that conidial coils were small (10-12 μm wide) and only once or twice coiled. The aspect of ascomata and sizes of structures determined my identification.

Tubeufia sect. *Nectrioidea* Barr, sect. nov.

Ascomata globosa vel ovoidea, pigmentifera vivide; peridium hyphis vel cellulis protrudentibus ornatum.
Species typica: *T. cerea.*

Tubeufia cerea is the only species of the section recognized from temperate North America. *Tubeufia palmarum* (Torrend) Samuels et al. and *T. aurantiella* (Penz. & Sacc.) Rossman are tropical members of the section.

Samuels et al. (1979) noted that in both *T. cerea* and *T. palmarum* conidia arise from thin-walled pegs that proliferate sympodially and that no apparent scar remains on either the conidium or the conidiogenous peg after dehiscence. *Helicosporium vegetum* is the conidial state of *T. cerea*, whereas that of *T. palmarum* is *Helicomyces*-like, with conidia one celled and hooked rather than coiled.

Tubeufia cerea (Berk. & Curt.) von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 128: 562. 1919. Figs. 14, 15

Sphaeria cerea Berk. & Curt. Grevillea 4: 108. 1876.
Calonectria cerea (Berk. & Curt.) Sacc. Syll. Fung. 2: 551. 1883.
Ophionectria cerea (Berk. & Curt.) Ell. & Ev. North Amer. Pyrenomycetes, p. 118. 1892.
Nectria fulvida Ell. & Ev. J. Mycol. 1: 140. 1885.
Calonectria fulvida (Ell. & Ev.) Berl. & Vogl. Addit. Syll. Fung. p. 212. 1886.
Dialonectria fulvida (Ell. & Ev.) Ell. & Ev. J. Mycol. 2: 122. 1886.
Ophionectria briardi Boudier, Rev. Mycol. p. 226. 1885.
Ophionectria episphaeria Karsten, Hedwigia 28: 26. 1889.
Ophionectria everhartii Ell. & Galloway, J. Mycol. 6: 32. 1890.
Calonectria belonospora Schroet. Krypt. Flora von Schlesien 3: 261. 1894.
Ophionectria belonospora (Schroet.) Sacc. Syll. Fung. 11: 366. 1895.
Ophionectria briardi var. *longipila* Starbäck, Bot. Not. 218-219. 1898.
Ophionectria belonospora var. *unicaudata* Feltgen, Vorstud. Pilz Luxemb. Nachtr. 3: 308. 1903.
Ophionectria cupularum Kirschst. Verh. Bot. Vereins Prov. Brandenburg 48: 60. 1906.
Ophionectria anonae Rao, Sydowia 25: 72-73. 1971.

Ascomata globose or ovoid, (90-)120-160 µm diam, greenish yellow, dull yellow, yellowish brown; peridium 22-33 µm wide in upper regions, 10-12 µm wide near base, surface usually pulverulent with protruding cells or with short hyphal appendages, 22-33 µm long, pigment as crystalline granules on walls of surface cells. Asci 55-74 x 7.5-12 µm, clavate; pseudoparaphyses narrow cellular. Ascospores elongate fusoid, (27-)30-52 x 2.5-3.5(-4.5) µm, hyaline, often curved, (5-)7-10-(13-)septate, not constricted at septa, cells containing numerous guttules, finally coalescing into one globule, wall smooth.

Conidial state: *Helicosporium vegetum*: Forming bright yellowish-green turf of upright setiform conidiophores, becoming ochraceous or brownish in age; conidiogenous cells produced laterally as thin-walled pegs. Conidia coiled two or three times, multiseptate, coils 10-15(-20) µm diam, cells 1-1.5 µm wide.

On overmature stromata of other Ascomycetes, and on surrounding wood.

Material examined: NORTH AMERICA: CANADA: Newfoundland: Waghorne 755a (NY); Quebec: Barr 2160 (MASS); Ontario: London, 3 Aug 1895, J. Dearness (FH, NY). USA: Maine: Barr 3337, 3359, 3360a, 3363, 5900c (MASS); York, 14 Sep 1891, R. Thaxter (FH, NY); New Hampshire: Barr 4000a (MASS); near Loring, Chocorua, W. G. Farlow (FH); Chocorua, Sep 1906, Aug 1910, Farlow (FH); Waterville, 1 Sep 1935, J. R. Hansbrough (NY); Shelburne, Sep 1889, R. Thaxter (FH, two collections); Vermont: Barr 4465, 4475 (MASS); Massachusetts: Barr 5240, 5199, 6012, 6013 (with *T. clintonii*) (MASS); Harvard Forest, Petersham, 19 Aug 1949, C. T. Rogerson (NY); New York: Camp Arnot, SE of Cayuga, Schuyler Co., 20 Sep 1970, Rogerson & G. J. Samuels (NY); Catskill Mts., Ulster Co., 1 Aug 1974, Rogerson et al. (NY); N. side of Hinckley Reservoir, Herkimer Co., 15 Sep 72, Rogerson et al. (NY); Stony Clove, Greene Co., 12 Oct 1968, Rogerson & S. J. Smith (NY); 4 mi. E. of Maplecrest, Greene Co., 8 Sep 1972, Rogerson & Samuels (NY); trail to Lake Ann, Mt. McGregor, Saratoga Co., 10 Oct 1968, Rogerson & Smith (NY); NE end of Lake Tiorati, Orange Co., 23 Oct 75, Rogerson (NY); Twin Valleys Camp, near Wadhams, Essex Co., 9 Sep 1967, Rogerson (NY); SE of Speculator, Hamilton Co., 4 Aug 1967, Rogerson & Smith (NY); Winnie Hill, N. of Oneonta, Otsego Co., 21 Sep 1963, Rogerson (NY); woods near Tompkins Pond, Dutchess Co., 9 Oct 1965, Rogerson (NY); Ellenville Ice Chasms, Ulster Co., 14 Aug 1963, Rogerson (NY); woods near Eagle Valley, Orange Co., 28 Jun 60, Rogerson & R. H. Petersen (NY); Pack Demonstration Forest, Warren Co., 25 Sep 1971, Rogerson (NY); same data, Samuels (NY); Indian Pass Trail, Essex Co., 14 Aug 1970, Rogerson et al. (NY); West Canada Creek, Trenton Falls, Herkimer Co., 19 Sep 1969, Rogerson et al. (NY); Lake Sherman, Warren Co., 25 Sep 1971, Samuels (NY); S. J. Smith 45649, 45665 (NY ex NYS); New Jersey: Ellis & Everhart, Fungi Col. 1361 (MASS); Newfield, Oct 1885, J. B. Ellis (NY as *Nectria fulvida*;FH, type of *N. fulvida*); Newfield, 6 Jul 1890, type of *Ophionectria everhartii* (FH); Hutcheson Memorial Forest, Somerset Co., 27 Oct 1970, Rogerson et al. (NY); Michigan: Barr 5388 (MASS); Cross Village, Emmet Co., 24 Jul 1962, Rogerson (NY); Whitehouse Landing Road, Chippewa Co., 25 Jul 1967, Rogerson (NY); near Upper Falls, Tahquamenon State Park, Luce Co., 3 Aug 1964, Rogerson (NY); Rees's Bog, N. of Burt Lake, Cheboygan Co., 9 Aug 1971, Rogerson (NY); Mackinaw City, Emmet Co., 9 Aug 1971, Rogerson (NY); S. of Whitefish Bay, Hiawatha National Forest, Chippewa Co., 11 Aug 1971, Rogerson (NY); Ohio: Ellis & Everhart N.A.F. 2598 (MASS); Illinois: Allerton Park near Monticello, Piatt Co., 15 Aug 1965, Rogerson (NY); Minnesota: Cloquet Forest Research Center, St. Louis Co., 25 Aug 1972, Rogerson (NY); North Carolina: Highlands, Macon Co., 13 Aug 1961, Petersen & Rogerson (NY); Collins Creek, Swain Co., 18 Oct 1960, Rogerson (NY); Utah: Mt. Ogden Park, Ogden, Weber Co., 12 Jun 1971, Rogerson (NY). EUROPE: BELGIUM; ex IMI 68112 (NY); AUSTRIA: Rehm Ascom. 1783 (NY). USSR: Mycotheca Rossica 120 as *Ophionectria belonospora* (BPI, NY).

Tubeufia cerea is the most common north-temperate representative of the genus. This species is readily recognized under low magnification by the yellowish pulverulent ascomata that are globose with a somewhat collabent aspect. Old stromata of *Diatrype stigma* (Hoffm. ex Fries) Fries, *Graphostroma platystoma* (Schw.) Piroz., and species of *Eutypa*, *Eutypella*, and *Hypoxylon* are the most common substrates, but the species has been collected over other fungi, e.g., *Bertia moriformis* (Tode ex Fries) de Not.

The synonymy for the ascosporic state is essentially that provided by Rossman (1977) while that for the conidial state is taken from Hughes (1958). *Ophionectria palmarum* Torrend is now recognized as a species of *Tubeufia* (Samuels et al., 1979). Rossman (1979) added as probably synonymous with *T. cerea Calonectria aurea* Ade (Hedwigia 64: 304. 1923) (non *C. aurea* (Crouan & Crouan) Sacc., 1878).

Munk provided the first "modern" description of *T. cerea* (1957, as *Ophionectria cerea*). Both Barr (in Bigelow and Barr, 1963) and Booth (1964) made the unnecessary combination of *Tubeufia cerea*, without realizing that von Höhnel (1919) had already transferred the species. Booth described and illustrated the species in detail.

Tubeufia sect. *Thaxteriella* (Petrak) Barr, stat. nov.
Thaxteriella Petrak, Ann. Mycol. 22: 63. 1924.

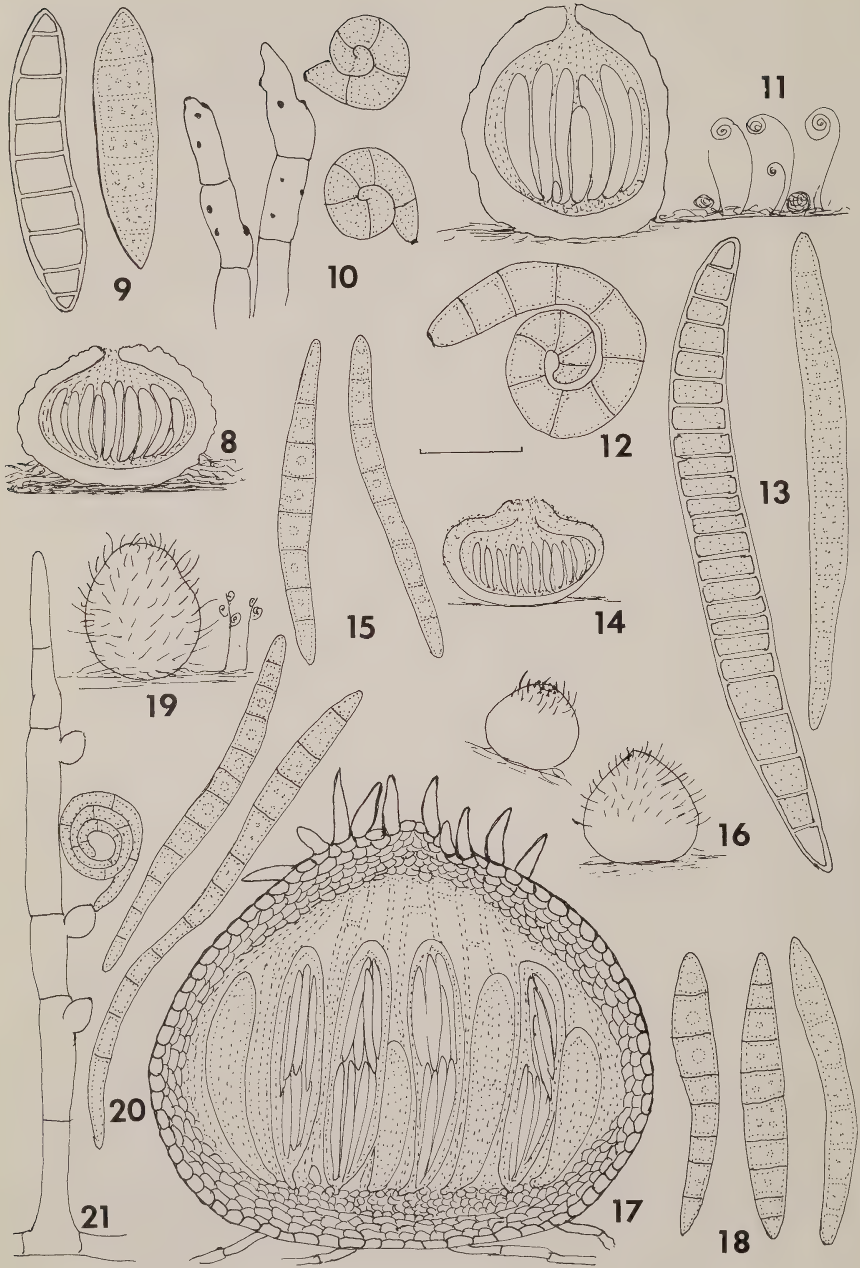
Ascomata globose or ovoid, vinaceous, grayish or blackish brown pigmented; peridium smooth or ornamented with protruding cells or short thick-walled hyphae.

Type species: *Thaxteriella corticola* Petrak (= *Tubeufia pezizula*).

Tubeufia pezizula usually has a well-developed subiculum, ascomata that are collabent when dry, and produces *Helicoma* conidia. The ascospores are shorter and wider than those of *T. helicoma*, in which the subiculum is often poorly developed and the ascomata are not collabent on drying. Other species belonging in this section are *T. amazonensis* Samuels et al., *Thaxteriella roraimensis* Samuels & Müller, and probably *Tubeufia corynespora* Munk. *Thaxteriella indica* Dharme & Müller (Sydowia 23: 77-78. 1970 (1969)) probably belongs here too. This species is similar in aspect to *Tubeufia pezizula* but is larger -- the ascospores are 15-20-septate and measure 60-100 x 9-12 μm.

The *Helicoma* states of *Tubeufia pezizula* and *Thaxteriella roraimensis* bear at each conidiogenous locus a flat, refractive scar but not an obvious pore, whereas in *Tubeufia paludosa* the locus appears as a refractive, circular, cicatrized scar with a pore in the middle (Samuels and Müller, 1979; Samuels et al., 1979).

Tubeufia pezizula (Berk. & Curt.) Barr, comb. nov. Figs.8-10
Sphaeria pezizula Berk. & Curt. Grevillea 4: 106. 1876.
Lasiosphaeria pezizula (Berk. & Curt.) Sacc. Syll. Fung. 2: 195. 1883.
Herpotrichia pezizula (Berk. & Curt.) Ell. & Ev. North Amer. Pyrenomycetes p. 160. 1892.
Thaxteriella pezizula (Berk. & Curt.) Petrak, Sydowia 7: 110. 1953.
Sphaeria helicophila Cooke, Grevillea 6: 145. 1878.
Melanomma helicophilum (Cooke) Sacc. Syll. Fung. 2: 112. 1883.



Byssosphaeria helicophila (Cooke) Cooke, Grevillea 15: 123. 1887.

Thaxteriella corticola Petrak, Ann. Mycol. 22: 63. 1924.

Ascomata globose, (220-)300-450 µm diam, collabent on drying, reddish or vinaceous brown to dull grayish brown or blackish, surface dull or shining, apex with broad blunt pore area; peridium 30-50(-55) µm wide, nearly equal in width throughout, cells large, outer layers vinaceous brown, paler toward interior, surface smooth or roughened by protruding cells with encrusting pigment. Asci 100-145 x 20-32 µm, clavate, pseudoparaphyses narrowly cellular. Ascospores elongate fusoid, (25-)35-60(-65) x (4-)8-12(-13) µm, hyaline, becoming dull yellowish brown in age except end cells remaining hyaline, (5-)7-9-(11-)septate, not constricted at the septa, cell contents minutely guttulate becoming homogenous and refractive, walls smooth.

Conidial state: *Helicoma muelleri* Corda, Icon. Fung. 1: 15. 1837.

Helicosporium muelleri (Corda) Sacc. Michelia 2: 129. 1880.

Helicomyces muelleri (Corda) Pound & Clements, Bull. Minnesota Geol. Nat. Hist. Surv. 9: 659. 1896.

Helicoma curtisii Berk. Grevillea 3: 106. 1875.

Helicomyces curtisii (Berk.) Pound & Clements, Bull. Minnesota Geol. Nat. Hist. Surv. 9: 659. 1896.

Helicosporium tiliae Peck, Bull. Torrey Bot. Club 34: 103. 1907.

Figs. 8-10. *Tubeufia pezizula* (Barr 5456): 8. Outline of ascoma in dense subiculum. 9. Ascospores. 10. Tips of conidiophores and two conidia. Figs. 11-13. *T. helicoma*: 11. Outline of ascoma in turf of conidiophores and conidia (Linder 811, type of *Lasiosphaeria nematospora*). 12. Conidium (Linder 811). 13. Ascospores (left, Thaxter, Chile; right Plowright, type of *Sphaeria helicoma*). Figs. 14, 15. *T. cerea*: 14. Outline of ascoma (Barr 5240). 15. Ascospores (Barr 3337). Figs. 16-18. *T. clintonii*: 16. Outline of ascomata (upper, type of *Acanthostigma nectrioideum*, Java; lower, Peck, type of *Sphaeria clintonii*). 17. Ascoma in section (Barr 6013). 18. Ascospores (Peck, type of *Sphaeria clintonii*). Figs. 19-21. *T.scopula*: 19. Outline of ascoma (Ellis, 1880). 20. Ascospores (Peck, type of *Sphaeria scopula*). 21. Conidiophore bearing conidiogenous cells and conidium (Ellis, 1880). Standard line = 60 µm for Fig. 17; 15 µm for Figs. 9, 10, 12, 13, 15, 18, 20, 21); 150 µm for Figs. 8, 11, 14, 16, 19.

Conidiophores arising from recumbent hyphae of subiculum, brown or nearly black; conidia from terminal conidial denticle, or two or three from sympodial succession of terminal denticles; conidia coiled ca. 1½ times, hyaline or light brownish, septate, up to 20 µm wide in coil, cells. ca. 6-8 µm wide, wall smooth.

On dead woody branches or trunks, at times growing over other old Ascomycetes; collected from species of *Acer*, *Alnus*, *Berchemia*, *Castanea*, *Eugenia*, *Liquidambar*, *Populus*, *Prunus*, *Quercus*, *Tilia*, *Vitis*.

Material examined: NORTH AMERICA: CANADA: Ontario: London, J. Dearness (NY); Aurora, 1 Oct 1933, R. F. Cain (NY); USA: Maine: Barr 3568 (MASS); Kittery Point, Aug 1920, R. Thaxter (FH, NY); New Hampshire: Chocorua, Aug 1906, W. G. Farlow (FH); Shelburne, Aug 1891, Thaxter (FH); Intervale, 1901, Thaxter (FH); Massachusetts: Barr 6278 (MASS); Magnolia, July 1903, Farlow (FH); Waverly, Oct 1899, Thaxter (FH); Connecticut: W. C. Sturgis, no data (NY); New Haven, 1888-89, Thaxter (FH); West Haven, 1888-89, Thaxter (FH); New York: Michigan Hollow, near Danby, Tompkins Co., 4 Sep 1952, C. T. Rogerson (NY); New Jersey: Ellis N.A.F. 649 (MASS), 696b (MASS, NY); Ellis & Everhart Fungi Col. 1624 (MASS); Newfield, Apr 1878, 18 Apr 1878, Summer 1878 (FH), Feb 1880, 4 Nov 1887, all J. B. Ellis (NY); Michigan: Barr 5456 (MASS); Pennsylvania: Bethlehem, Oct 1880 (NY); Moshannon Dam, Center Co., 8 Oct 1939, J. W. Sinden (NY); Ohio: Morgan 611 (NY); Preston, 1887, A. P. Morgan (FH); Illinois: Metropolis, Oct 1919, C. J. Humphrey (BPI); Allerton Park near Monticello, Piatt Co., 15 Aug 1965, Rogerson (NY); South Carolina: Ellis N.A.F. 967 (MASS); Georgia: Ellis N.A.F. 696a (MASS, NY); Barr 6448, 6469 (MASS); GA numbers 7515-7523 inclusive (GA); Alabama: Auburn, 11 Jan 1896 (NY), 1 Feb 1896, F. S. Earle & L. M. Underwood (BPI, NY); Jan 1897 (BPI, NY); 16 Jan 1897 (BPI, NY); Florida: GA numbers 7524, 7525, 7526 (GA); Ravenel Fungi Amer. Exs. 196 (FH, NY); Longwood, 9 Feb 1940, C. L. Shear (BPI); Brooksville, 7 Mar 1942, Shear (NPI); Plymouth, 27 Mar 1893, Mar 1895, W. C. Sturgis (NY); Mar 1893 (FH); Louisiana: Barr 6338c (MASS); St. Martinsville, 20 Nov 1890, 19 Apr 1888, A. B. Langlois (FH); Missouri: Comm. Dr. Winter, June 1884 (NY); Rabenhorst-Winter-Pazschke, Fungi eur. 3962 (NY). BERMUDA: Expl. of Bermuda 1413-b, 1437-b, 1528 (NY). JAMAICA: 1909, A. E. Wright (FH). PUERTO RICO: West Indian Expl. 1013 (NY); Dorado, 26 July 1913, J. R. Johnston (NY). GUADELOUPE: Riviere St. Louis, 1902, P.Duss

(NY); GRENADA: Grand Etang, R. Thaxter (NY).

Pirozynski (1972) also described the fungus from Africa, and Goos (1980) reported it from Hawaii.

Linder (1929) described both the ascosporic and conidial states of *Tubeufia pezizula* (as *Lasiosphaeria pezizula* and *Helicoma curtisii*). Hughes (1958) clarified nomenclature of *Helicoma muelleri*, the type species of the genus, and included *Helicosporium tiliae* in synonymy. Pirozynski (1972) added *Helicoma curtisii* to synonymy and provided descriptions and illustrations of variation in both states of the species.

Tubeufia helicoma (Phill. & Plowr.) Pirozynski, Mycol. Pap. 129: 30. 1972. Figs. 11-13
Sphaeria helicoma Phill. & Plowr. Grevillea 6: 26. 1877.
Lasiosphaeria helicoma (Phill. & Plowr.) Sacc. Syll. Fung. 2: 192. 1883.
Lasiosphaeria nematospora Linder, Ann. Missouri Bot. Gard. 16: 289. 1929.
Tubeufia rugosa Booth, Mycol. Pap. 94: 13. 1964.

Ascomata globose or ovoid, (130-)180-385 µm diam, (150-) 208-550 µm high, light brown, grayish brown, or blackish brown, surface glabrous, pulverulent or rugulose with protruding cells, apex broadly rounded, opening by small pore; peridium of pseudoparenchymatous cells, 26-32 µm wide. Asci 120-200 x 15-25 µm, broadly cylindric, pseudoparaphyses narrow cellular, extending into apical pore region. Ascospores (52-)60-100(-130) x 4-6.5(-8) µm, hyaline or light yellowish, elongate clavate, tapering to ends, more strongly tapering to basal end, (7-)9-15-25-septate, slightly or not constricted at septa, cell contents multiguttulate, in one or two parallel fascicles in the ascus.

Conidial state: *Helicosporium pannosum* (Berk. & Curt.) R. T. Moore, Mycologia 49: 582. 1957.
Drepanospora pannosa Berk. & Curt. apud Berk. Grevillea 3: 105. 1875.
Helicosporium serpentinum Linder, Ann. Missouri Bot. Gard. 16: 288. 1929.
Helicosporium nematosporum Linder, Ann. Missouri Bot. Gard. 16: 288. 1929.
Helicosporium elinorae Linder, Ann. Missouri Bot. Gard. 16: 290. 1929.

Turf brown, conidiophores arising from recumbent hyphae; conidia coiled, coils (35-)45-60(-100) µm diam, cells 4.5-8 μm wide. Also present in some collections dark brown, muriform, globular "conidia," 32-40 μm diam, in the turf (perhaps initials of ascomata).

On dead, decaying woody branches and logs, on sawdust, and on large monocot culms.

Material examined: NORTH AMERICA: USA: Louisiana: Honey Island Swamp, near Pearl River, St. Tammany Parish, 6 Jun 1976, S. J. Hughes (rotten log) (NY, ex DAOM 155883). SOUTH AMERICA: BRITISH GUIANA: Plantation Vryheid, Demerara River, 2 Feb 1924, D. H. Linder 881 (two collections, type of *Lasiosphaeria nematospora* according to labels, FH); Reliquiae Farlowianae 842, same collection data, on sheaths of manicole palm (*Euterpe* sp.) (FH, NY); Botanic Garden, Georgetown, 4 Oct 1923, Linder 236, palm sheath (with slide, FH). CHILE: Corral, Dec 1905, 1905-1906, R. Thaxter, on decorticated wood (FH, two collections). EUROPE: ENGLAND: Sphaeriacei Britannici III, 53 (C. B. Plowright), Brandon, Nov 1876, on sawdust (isotype, NY).

Pirozynski (1972) recorded collections from Tanzania and New Zealand, while Hughes (1978) added a number of collections from New Zealand, reporting that it was a common species in that country. Goos (1980) reported the fungus from Hawaii.

Linder (1929) described the ascospores of *Lasiosphaeria nematospora* as 45-58 x 3.1-3.6 μm and 5-11-septate, but in the authentic material that I examined they measured 100-130 x 4-5 μm and were up to 25-septate. While Pirozynski included *Helicosporium elinorae* as one of the synonyms of the conidial state of *Tubeufia helicoma*, he observed that *Lasiosphaeria elinorae* is indeed a species of *Lasiosphaeria*. Pirozynski (1972) described *T. helicoma* in detail, and suggested that *Helicosporium viride* (Corda) Sacc. and its synonymous names were probably identical with *H. pannosum;* presumably also *H. indicum* P. R. Rao & D. Rao and *H. nizamabadense* P. R. Rao & D. Rao (Mycopathol. Mycol. Appl. 24: 27-34. 1964) are variants of the same fungus.

Tubeufia sect. *Acanthostigmina* (v. Höhnel) Barr, stat. nov.
Acanthostigmina v. Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 118: 1499. 1909.

Ascomata globose or ovoid, vinaceous or dark brown pigmented; peridium ornamented with dark brownish-black setae.

Type species: *Sphaeria clintonii* Peck.

Tubeufia clintonii and *T. scopula* are similar in aspect and differ from other species in *Tubeufia* by the presence of dark setae on the ascomata. The peridium, however, is soft and vinaceous tinged, similar to peridia in species of sect. Thaxteriella. The two species are readily separated by ascospore sizes. No conidial state has been associated with certainty with *T. clintonii*, but a *Helicosporium* state, agreeing with *H. aureum*, is associated with ascomata in several collections of *T. scopula*.

Tubeufia clintonii (Peck) Barr, comb. nov. Figs. 16-18

Sphaeria clintonii Peck, Ann. Rep. New York State Mus. 30: 65. 1878 (for 1876).

Acanthostigma clintonii (Peck) Sacc. Syll. Fung. 2: 210. 1883.

Lasiosphaeria minuta Fuckel, Symb. Mycol. p. 148. 1870.

Acanthostigma minuta (Fckl.) Sacc. Syll. Fung. 2: 209. 1883.

Acanthostigmina minutum (Fckl.) v. Höhnel, Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl., Abt. 1, 118: 1499. 1909.

Acanthostigma nectrioideum Penzig & Sacc. Icon. Fung. Javanicorum, p. 18. 1904.

Ascomata globose or ovoid, 90-180(-240) µm diam, grouped or scattered on thin brown subiculum, with broad apex; peridium bright brown with vinaceous tinge, velvety over entire surface or around apex only with dark brown, stiff, pointed setae, (10-)30-90(-104) µm long, 4.5-6(-7.5) µm wide near base. Asci 50-90(-100) x (11-)13-20 µm, pseudoparaphyses narrow cellular. Ascospores (19-)32-45(-54) x (2.5-)3.5-5.5(-6) µm, elongate fusoid, often curved or bent, hyaline to light yellowish brown, (2-)5-7-(11-)septate, not constricted at septa, cell contents minutely guttulate, wall smooth.

Conidial state not known with certainty; a collection from New Jersey bears conidiophores from peridium of the ascomata and from basal subiculum. The conidiophores have lateral inflated cells. A few coiled conidia are present, coils ca. 30 µm diam, cells ca. 5 µm wide.

On rotting wood of deciduous trees, over old ascomycete stromata.

Material examined: NORTH AMERICA: CANADA: Quebec: Fabius 7230 (MASS); Ontario: Cattle Island, Lake Timagami, 8 Sep 1933, R. F. Cain (FH, NY). USA: New Hampshire: Shelburne, Aug 1894, W. G. Farlow (FH); Massachusetts: Barr 6013 with *T. cerea* (MASS); New York: Buffalo, Erie Co., Nov, G. W. Clinton ("Alden" in protolog) (type of *Sphaeria clintonii*, NYS); Michigan Hollow, Tompkins Co., 12 May 1947, J. Natti (NY); New Jersey: Newfield, 25 Mar 1889, J. B. Ellis (NY); Louisiana: St. Martinsville, 1 Jan 1890, A. B. Langlois (FH, Flora Ludoviciana 2243). BRITISH WEST INDIES: Grand Etang, Grenada, 1912-13, R. Thaxter (FH). SOUTH AMERICA: VENEZUELA: Dumont VE 2695 part (NY). EUROPE: Rehm Ascom. 1568; Sonntagsberg, 1906, Strasser (as *Acanthostigma minutum*,v. Höhnel Herb. in FH). ASIA: JAVA: Tjibodas, 1897, v. Höhnel (two slides in v. Höhnel Herb. in FH, as *A. nectrioideum*).

The specimens that von Höhnel (1909b) referred to in erecting *Acanthostigmina* are identical with North American collections. Although Fuckel's *Lasiosphaeria minuta* is the oldest name, the epithet cannot be utilized in *Tubeufia* because of *T. minuta* Munk (1966).

Tubeufia scopula (Cooke & Peck) Barr, comb. nov. Figs. 19-21
Sphaeria scopula Cooke & Peck, Ann. Rep. New York State Mus. 32: 51. 1880. "1879" (for 1878).
Acanthostigma scopula (Cooke & Peck) Peck, Bull. New York State Mus. 1(2): 22. 1887.
Lasiosphaeria scopula (Cooke & Peck) Sacc. Syll. Fung. 9: 852. 1891.

Ascomata globose conic or ovoid, 165-280(-385) μm diam, covered thickly with dark, nonseptate setae, 37-90 μm long, 4.5-7.5 μm wide near base; peridium vinaceous brown, relatively soft, pseudoparenchymatous, 27-32 μm wide. Asci 67-100(-130) x 11-15(-22) μm, oblong, pseudoparaphyses narrow cellular. Ascospores (40-)56-80(-125) x (2-)2.5-3.5(-4.5) μm, hyaline, elongate fusoid, often bent or slightly curved, (6-)11-(13-)septate, not constricted at septa, cell contents minutely guttulate, wall smooth.

Associated conidial state: *Helicosporium aureum* (Corda) Linder, Ann. Missouri Bot. Gard. 16: 279. 1929.
Helicomyces aureus Corda, Icon. Fung. 1: 9. 1837.
Helicosporium pilosum Ell. & Ev. Bull. Torrey Bot. Club 24: 476. 1877.
? *Helicosporium olivaceum* Peck, Ann. Rep. New York State Mus. 27: 102. 1875 (for 1873).

Turf yellowish to olivaceous green, becoming dull brown, conidiophores elongate from recumbent hyphae, 390-600 µm long, 5.5-7.5 µm wide below and tapering to 2 µm wide above; conidiogenous cells lateral, inflated and bladderlike, 5.5 x 5.5-10 µm. Conidia pale yellowish in mass, coiled three times, coil 16-25 µm wide, cells 1-2.5 µm wide.

On decorticated coniferous wood, rarely on wood of deciduous trees.

Material examined: NORTH AMERICA: USA: New York: Adirondack Mts., Aug 1878, C. H. Peck (type of *Sphaeria scopula*, NYS); Knowersville, Albany Co., July, Peck (NYS); New Jersey: Newfield, Oct 1880, J. B. Ellis (two collections, NY); Newfield, Sep 1878, Ellis (FH); 1877, Ellis (NY); Ellis N.A.F. 125 of *Helicosporium olivaceum* (MASS); Florida: Grasmere, 30 Mar 1893, W. C. Sturgis (two collections, FH, NY); Louisiana: Ellis N.A.F. 184; Langlois Flora Ludoviciana 661 (FH, NY); Alabama: Tuskegee, 26 Aug 1901, G. W. Carver (FH). EUROPE: AUSTRIA: Wiener Wald, 21 May 1903, V. Höhnel (v. Höhnel Herb. in FH).

Tubeufia scopula is usually collected on coniferous substrates. The species has larger sizes than *T. clintonii* but otherwise is closely related.

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STUDIES IN
TROPICAL CORTICIACEAE (BASIDIOMYCETES) II

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SUMMARY

Four new genera and ten new species are described from Africa or adjacent areas viz. *Brevicellicium allantosporum*, *B. molle*, *B. uncinatum*, *Dextrinodontia* with the type species *D. molliuscula*, *Fibricium coriaceum*, *F. multicystidium*, *Hypochniciellum* with the type species *Leptosporomyces ovoideus* Jülich, *Melzerodontia* with the type species *M. aculeata*, *Odontiopsis* with the type species *O. hyphodontina*, *Phlebia verruculosa*, and *Repetobasidium hastatum*. A key to known species of *Brevicellicium* is presented, and two species are reported as new to Africa viz. *Hypochniciellum ovoideum* and *Repetobasidium mirificum*.

Key to species of *Brevicellicium*

1. Spores reniform or allantoid..........*B. allantosporum*
1. Spores subglobose-globose..............................2

2. Fruitbody smooth.....................................3
2. Fruitbody grandinioid to odontioid...................5

3. Fruitbody pellicular, with distinct white subiculum, known from Brazil...............*B. mellinum*
3. Fruitbody not distinctly pellicular, subiculum inconspicuous 4

4. Hyphae provided with small hooks which are easily observed at the subhymenial hyphae, spores subglobose

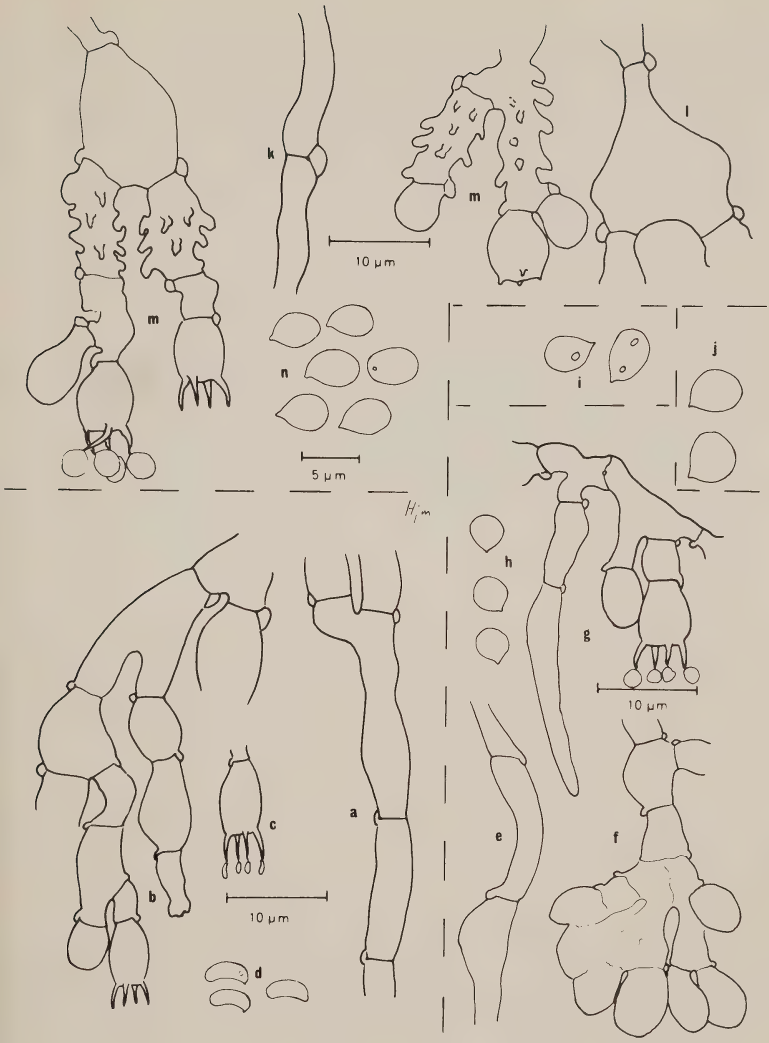

Fig. 1. *Brevicellicium allantosporum*, coll. Ryv. 10601. a) basal hypha b) subhymenial hyphae with basidia c) single basidium with immature spores d) spores. *B. molle*, coll. Ryv. 11013. e) basal hypha f) subhymenial hyphae and basidia-cluster g) basidia and cystidial element h) spores. B. exile, coll. Hjm 7536. i) spores. B. olivascens, coll. Hjm 9479. j) spores. *B. uncinatum*, coll. Ryv. 10023. k) basal hypha l) isodiametric hypha m) subhymenial hyphae and basidia n) spores.

or rarely globose, 3.5-4.5 x 3-3.5 um.......B. uncinatum
4. Hyphae smooth, spores more short-ellipsoid
or lacrimiform, 4.5-5(-6) x 3.5-4 um............B. exile

5. Spores generally 3.5-4(-4.5) um.................B. molle
5. Spores up to 5(-5.5) um across........................6

6. Fruitbody yellowish to light greenish.......B. viridulum
6. Fruitbody whitish to cream coloured........B. olivascens

BREVICELLICIUM Larss. & Hjortst., Mycotaxon 7(1):117, 1978.

This genus was described to accomodate such species as Corticium exile Jacks. (type species) and Odontia olivascens Bres. The basic characteristics were the isodiametric subhymenial hyphae, short basidia and globose to subglobose spores. Two of the species described below include such characteristics while B. molle also has cystidia or hyphal ends. The third species B. allantosporum has the same isodiametric hyphae, but the spores are different making the species deviate somewhat. However, even the latter species with allantoid spores and B. molle with cystidial organs does not seem to change the generic description basically.

BREVICELLICIUM ALLANTOSPORUM Hjortst. & Ryv. nov.spec.

Fructificatio resupinata, effusa, laxe adnata; hymenio albido vel ravido, sub lente distincte granulato; aculeis circiter 0.1-0.2 mm longis; systemate hyphali monomitico; hyphis basalibus rectis, 3-4 um latis; hyphis subhymenialibus dilatatis, parietibus isodiametris, 7-8(-10) um latis, cum fibulis; cystidiis nullis; basidiis clavatis, 10-12 x 4 um, 4-sterigmatibus; sporis reniformibus vel allantoidibus, tenuitunicatis, 4 x 1.5-1.75 um, non-amyloidibus.

Holotypus: Africa. Tanzania. Tanga Prov. Tanga distr., Usambara Mts., Amani, alt. 800-1000 m. 18.-19. Febr. 1973. L. Ryvarden 10601 (O).

Fruitbody resupinate, effuse, loosely adnate, under a lens (50X) distinctly grandinioid with small aculei, ab. 0.1-0.2 mm, whitish to greyish-white. Hyphal system monomitic. Basal hyphae straight, 3-4 um wide, subhymenial ones isodiametric and up to 7-8(-10) um wide, all hyphae with clamps. Cystidia lacking. Basidia clavate, short, 10-12 x 4 um with four sterigmata. Spores reniform or allantoid, thin-walled, often with two oil-drops, 4 x 1.5-1.75 um, non-amyloid.

Remarks. This species is closely related to other species in the genus Brevicellicium, and the diagnostic features of the new species are the granular hymenium and the allantoid or reniform spores.

BREVICELLICIUM MOLLE Hjortst. & Ryv. nov.spec.

Fructificatio resupinata, effusa, laxe adnata; hymenio plus minusve cremeo, sub lente distincte granulato; aculeis minus 0.2 mm; systemate hyphali monomitico; hyphis basalibus rectis, parietibus fere parallelis, usque ad 4 um latis; hyphis subhymenialibus dilatatis, parietibus isodiametris, vulgo 7-8 um latis, cum fibulis; cystidiis nullis sed interdum in hymenio hyphis cystidioideis praesentibus, circiter 20-25 x 4 um; basidiis clavatis, generatim 10 x 6 um, 4-sterigmatibus; sporis oblique subglobosis, tenuitunicatis, 3.5-4 um diametro, non-amyloidibus.

Holotypus: Africa. Tanzania. Morogoro Prov. Morogoro distr., Uluguri Mts., Morning Side Res. st. c. 5 km S of Morogoro, alt. c. 1500-2100 m. 24.-26. Febr. 1973. L. Ryvarden 11013 (O).

Fruitbody resupinate, effuse, loosely adnate, under a lens (50X) grandinioid, aculei small, less than 0.2 mm, but easily observed. Hyphal system monomitic with the basal hyphae straight, up to 4 um wide, subhymenial hyphae widened, isodiametric and usually up to 7-8 um wide or more, all hyphae with clamps. Cystidia lacking, but occasionally some hyphal ends project above the basidia, ab. 20-25 x 4 um. Basidia clavate, short, in general 10 x 6 um, with 4 sterigmata. Spores oblique subglobose, thin-walled, 3.5-4 um across, non-amyloid.

Remarks. This species is easily recognized by its soft fructification, small subglobose spores and hyphal ends or cystidioles between the basidia. It is closely related to B. olivascens, but this species has less soft fructification and the spores are larger, often up to 5 um or more. Compare also the figured spores of B. exile.

BREVICELLICIUM UNCINATUM Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata, levis, plus minusve farinosa vel porulosa, albida vel cinerescens; systemate hyphali monomitico; hyphis basalibus distinctis sed paucis, rectis, tenuitunicatis, passim dilatatis, levibus, circiter 3 um latis; hyphis subhymenialibus item distinctis sed cellulis brevibus; parietibus isodiametris, usque 10 um latis, uncis lateralibus instructis; cystidiis nullis; basidiis subglobosis, plerumque 7-9 x 5-6 um, 4-sterigmatibus; sporis subglobosis raro globosis, tenuitunicatis, levibus, (3.5-)4-4.5 x (3-)3.5 um, neque amyloidibus neque cyanophilis.

Holotypus: Africa. Tanzania. Arusha Prov. Arusha Nat. Park. Mt. Meru E slope, road to the crater, alt. 1800-2300 m. 8. Febr. 1973. L. Ryvarden 10023 (O).

Fruitbody resupinate, effuse, closely adnate, smooth, more or less farinose, especially at the margin, becoming continuous and appears to be slightly porulose-reticulate, whitish or greyish. Hyphal system monomitic. Subicular hyphae few, fairly straight but widened near the septa, usually smooth, ab. 3 um wide. Subhymenial hyphae isodiametric and sometimes up to 10 um wide, provided with unciform outgrowths, born on sides of the hyphae. These outgrowths are very distinctive and occur frequently on the subhymenial hyphae, rarely on the basal and basidia-bearing hyphae. Cystidia lacking. Basidia subglobose, without unciform outgrowths, usually 7-9 x 5-6 um, with 4 sterigmata. Spores subglobose, thin-walled, smooth, 4-4.5 x 3.5 um, with distinct apiculus, non-amyloid and without cyanophilous reaction.

Remarks. This species seems to be closely related to other species in *Brevicellicium*, preferably *B. olivascens* but also to *B. exile* in its isodiametric hyphal cells. It is distinguished in having more regularly subglobose and smaller spores than in *B. olivascens*, where they are asymmetric and usually up to 4.5-5 um. *B. uncinatum* is further separated from all other species in the genus by the hook-shaped outgrowths from the hyphae, which are very distinctive and easily observed.

DEXTRINODONTIA Hjortst. & Ryv. nov.gen.

Fructificatio resupinata, effusa, valde adnata, hydnoides, mediocriter mollis; systemate hyphali dimitico; hyphis skeleticis crassitunicatis, implexis, sine ramis vel sparsim ramosis, perspicue dextrinoidibus et cyanophilis, fibulis nullis; hyphis generatoris tenuitunicatis, omnibus fibulatis; cystidiis nullis; basidiis plus minusve clavatis, terminalibus, 4-sterigmatibus; sporis tenuitunicatis, levibus, non-amyloidibus.

Typus generis: *Dextrinodontia molliuscula* Hjortst. & Ryv.

Fruitbody resupinate, effuse, distinctly hydnoid, fairly soft. Hyphal system dimitic. Skeletal hyphae thick-walled, sparsely ramified, clearly dextrinoid and with strong cyanophilous reaction, without clamps. Generative hyphae thin-walled, with clamps at all septa. Cystidia lacking. Basidia more or less clavate, 4-sterigmated. Spores thin-walled, smooth, non-amyloid.

Remarks. *Dextrinodontia* is in presence of hydnoid hymenium and with dextrinoid and cyanophilous skeletal hyphae quite different from other genera in the family *Corticiaceae* and in our judgement easily recognized. In general appearance the new genus approaches *Fibrodontia* Parm., *Fibricium* John Erikss., and *Fibriciellum* Erikss. & Ryv. but species in these genera do not have dextrinoid hyphae. *Fibriciellum silvae-ryae* Erikss. & Ryv. has cyanophilous skeletal hyphae but is different in other respects.
Other odontioid or hydnoid genera with dimitic hyphal system are *Steccherinum* and *Mycoaciella*. Both lack the cyanophilous and dextrinoid reaction of hyphae and the former is further separated by large and encrusted cystidia. Besides, *Mycoaciella* has when fresh a ceraceous consistency and becomes horny when drying.

Dextrinoid skeletal hyphae are found in Scytinostroma (Lachnocladiaceae) but any relationship to this genus seems to be far-fetched. Most of the species in Scytinostroma have a generally smooth and tough fruitbody, gloeocystidia are present in most species and also dendrohyphidia or skeletohyphidia occur.

DEXTRINODONTIA MOLLIUSCULA Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, hydnoides, plus minusve mollis; colore diluto ochraceo; aculeis circiter 2 mm longis, cylindraceis vel conicis; margine fibrilloso vel saepe cum rhizomorphis praesentibus; systemate hyphali dimitico; hyphis skeleticis crassitunicatis, implexis, passim ramosis, 2 um latis, dextrinoidibus et cyanophilis, fibulis nullis; hyphis generatoris tenuitunicatis, ramosis, 2-2.5(-3) um latis, fibulatis; cystidiis nullis; basidiis plus minus-

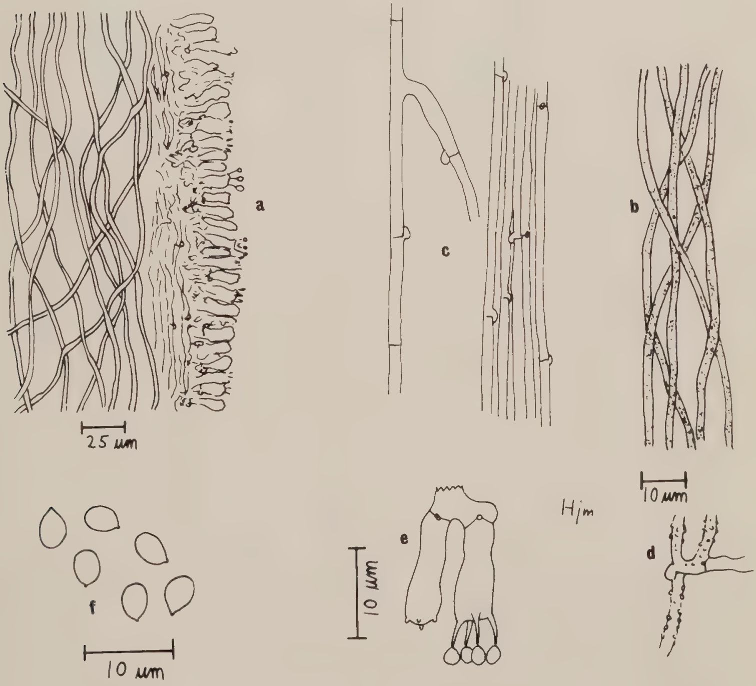

Fig. 2. Dextrinodontia molliuscula, coll. Ryv. 10236. a) part of the aculeus b) skeletal hyphae (in Melzer´s reagent) c) thin-walled generative hyphae d) encrusted subhymenial hyphae e) basidia f) spores.

ve clavatis, terminalibus, 4-sterigmatibus, plerumque 12-15 x 4 um; sporis subglobosis vel leviter dacryoidibus, tenuitunicatis, 3.5(-4) x 2.5-3 um, non-amyloidibus.

Holotypus: Africa. Tanzania. Kilimanjaro Prov. Mt. Kilimanjaro W slope, W Kilimanjaro Forest sta., alt. c. 1800 m. 10.-11. Febr. 1973. L. Ryvarden 10236 (O). Isotypus in Herb. GB. Paratypus: do. L. Ryvarden 10202 (O). Kenya. Central Prov. Mt. Elgon, Suam Forest sta., alt. c. 2100 m. 23.-24. Jan. 1973. L. Ryvarden 9223 (O).

Fruitbody resupinate, effuse, hydnoid, sometimes with flattened teeth, soft, in colour light ochraceous, aculei about 2 mm long, cylindrical or conical, margin fibrillose or distinctly rhizomorphic. Hyphal system dimitic. Skeletal hyphae thick-walled and occur both in the subiculum and intricately entangled in the central part of the aculei, rarely branched, ab. 2 um wide, dextrinoid and strongly cyanophilous, without clamps. Generative hyphae thin-walled, in the subiculum long-celled, in the subhymenial part more short-celled and somewhat encrusted, 2-2.5(-3) um, the basidia-bearing hyphae fairly short-celled and tending to be more or less isodiametric, all generative hyphae with clamps, but simple adventitious septa may occur. Cystidia lacking. Basidia more or less clavate, terminal, with 4 sterigmata, in general 12-15 x 4 um. Spores subglobose to slightly dacryoid, thin-walled, smooth, 3.5(-4) x 2.5-3 um, non-amyloid.

Remarks. The diagnostic features of this species are the soft hydnoid fructification together with dextrinoid and strongly cyanophilous skeletal hyphae which are irregularly interwoven.

FIBRICIUM CORIACEUM Hjortst. & Ryv. nov. spec.

Fibricio lapponico affini sed differt cystidiis nullis.

Holotypus: Africa. Kenya. Eastern Prov. Nyeri distr., Mt. Kenya S slope,Regati Forest sta., alt. 2200-2300 m. 2.-3. Febr. 1973. L. Ryvarden 9779 (O). Paratypus: do. L. Ryvarden 9865 (O).

Externally the new species is close to Fibricium lapponicum John Erikss. and has the same construction of the texture e.g. two-layered, with a distinct subiculum composed of fibrous skeletal hyphae and a subhymenial layer of generative hyphae. The skeletal hyphae are strongly light-refracting in KOH but are not dextrinoid or cyanophilous. The basidia are constricted and measure 30-40 x 5-6 um, with 4 sterigmata. In comparison with F. lapponicum the spores are more subcylindrical, (5.5-)6-7 x (2-)2.5(-3) um.
Fibricium coriaceum is well recognized depending on its dimitic hyphal system and with the fruitbody soft leathery and easy to separate from the substrate. The hymenium corresponds with F. lapponicum but may be more compact and have a tendency to cracking with age. The most striking

characteristic is the absence of cystidia. In F. lapponicum these are usually encrusted and can be found in all well-developed collections.

FIBRICIUM MULTICYSTIDIUM Hjortst. & Ryv. nov.spec.

Fructificatio resupinata, effusa, leviter rimosa, in sicco plus minusve cremicolor, 0.1-0.3 mm crassa; margine minuto plus minusve fibrilloso; rhizomorphis sparsis; systemate hyphali dimitico; hyphis skeleticis crassitunicatis, fibrosis, 2-2.5 um latis, fibulis nullis; hyphis generatoris tenuitunicatis, ramosis, leniter incrustatis, hyalinis, 2-2.5 (-3) um latis, cum fibulis, hyphis omnibus neque amyloidibus vel dextrinoidibus neque cyanophilis; cystidiis multis, tenuitunicatis, cylindraceis, obtusis, manifeste constrictis, circiter 70 x 7 um; in hymenio hyphae paraphysoideae praesentes; basidiis clavatis, constrictis et plerumque sinuosis, 4-sterigmatibus, 35-40(-50) x 6(-7) um; sporis ellipsoidibus, levibus, tenuitunicatis, 8-10 x 4.5-5 um, non-amyloidibus.

Holotypus: Canary Islands. Tenerife, Monte Verde near Aguamansa in the Orotava valley, mixed forest. On Erica arborea. 8.-17. Jan. 1974. L. Ryvarden 12363 (O). Isotypus in Herb. GB.

Fruitbody resupinate, effuse, slightly cracking, white to cream-coloured, 0.1-0.3 mm thick, under a lens with projecting cystidia (20-30 um), margin more or less fibrillose, rhizomorphs sparse but may be well-developed in fresh material. Hyphal system dimitic. Skeletal hyphae thick-walled, fibre-like, without clamps and ramifications, usually 2(-2.5) um wide. Subhymenium composed of thin-walled, rather narrow hyphae, slightly encrusted (easily seen in cotton-blue), 2-2.5 um wide, the basidia-bearing hyphae somewhat wider, all generative hyphae with clamps. Hyphae neither amyloid or dextrinoid nor cyanophilous. Cystidia numerous, thin-walled, more or less cylindrical with the apex obtuse, constricted, ab. 70 x 7 um, widened at the apex, without aldehyde reaction. Paraphysoid hyphae occur between the basidia and usually project slightly. Basidia clavate, more or less sinuous, 4-sterigmated, 35-40(-50) x 5-6(-7) um. Spores ellipsoid, smooth, with oily contents, thin-walled, 8-10 x 4.5-5 um, non-amyloid.

Remarks. Fibricium multicystidium has the main features of other species in Fibricium e.g. smooth hymenium, fibrous skeletal hyphae, ellipsoid spores, and cylindrical cystidia. The spores are ellipsoid as in F. lapponicum and F. rude but larger.
The species has also some resemblance to species in Hypoderma, chiefly by having oily contents in the spores, but this genus is clearly delimited by a monomitic hyphal system. Our intention was to describe this species under a new generic name, but we are after a closer examination of the opinion that it is best placed in Fibricium, even if the spore-morphology and the narrow subhymenial hyphae are dif-

ferent. It is probable that future studies in the complex of dimitic species will give more information and change the present concept.

HYPOCHNICIELLUM Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, pellicularis vel membranacea; hymenio levi, byssoide; systemate hyphali monomitico; hyphis basalibus tenuitunicatis vel incrassatis, distinctis, pro parte majore rectis et uniformibus, hyalinis, fibulatis; hyphis subhymenialibus tenuitunicatis, sinuolatis, fibulatis; cystidiis nullis; basidiis parvis, plus minusve clavatis, modice constrictis, 4-sterigmatibus; sporis crassitunicatis, levibus, neque amyloidibus neque dextrinoi-

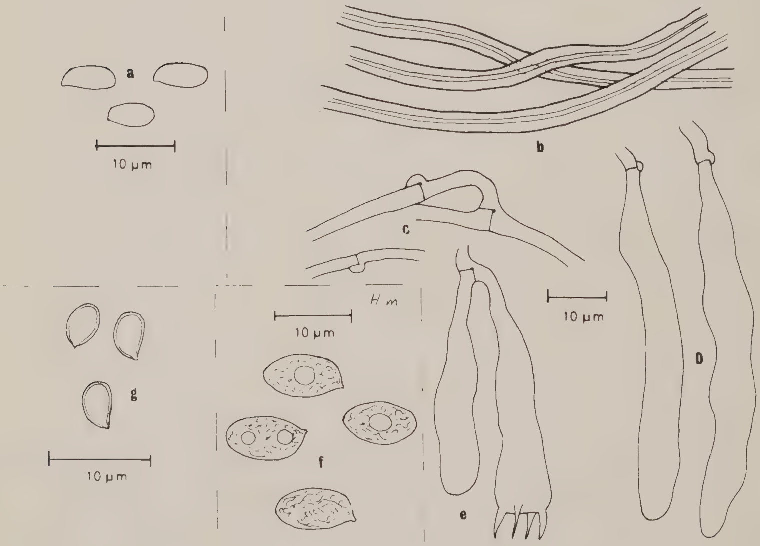

Fig. 3. Fibricium coriaceum, coll. Ryv. 9779. a) spores. F. multicystidium, coll. Ryv. 12363. b) fibrous skeletal hyphae c) generative hypha d) cystidia e) basidia f) spores. Hypochniciellum ovoideum, coll. Hjm 3121 (from Sweden). g) spores.

dibus, perspicue cyanophilis.

Typus generis: *Leptosporomyces ovoideus* Jülich

Fruitbody resupinate, effuse, pellicular (athelioid) or thin membranaceous, hymenium smooth, more or less byssoid. Hyphal system monomitic. Basal hyphae with walls thin to thickened, distinct, partly straight and uniform, hyaline, subhymenial hyphae thin-walled, faintly sinuate, all hyphae with clamps. Cystidia absent in the type species. Basidia fairly small, more or less clavate, moderately constricted, with 4 sterigmata. Spores thick-walled, smooth, distinctly cyanophilous, non-amyloid or dextrinoid.

Remarks. The new genus *Hypochniciellum* is easily separated from *Athelia* and *Leptosporomyces* by its thick-walled and cyanophilous spores. In the spore-morphology it is similar to species in *Hypochnicium* but well delimited by pellicular and detachable fructification with a very thin subiculum. Some other species, that may be placed in *Hypochniciellum* are *Leucogyrophana subillaqueata* (Litsch.) Jülich, *L. cremeoisabellina* (Litsch.) Parm., and *L. mollis* (Fr.) Parm. All these species are similar to *H. ovoideum* in the morphology of the hyphae, basidia, and spores but differs in having slight amyloid spore-reaction (greyish). Compare Eriksson and Ryvarden (1976). None of the species are hitherto known from the tropics.

HYPOCHNICIELLUM OVOIDEUM (Jülich) Hjortst. & Ryv. comb. nov.

Basionym: *Leptosporomyces ovoideus* Jülich, Willdenowia Beih. 7:203-204, 1972.

Fully described and figured by Jülich (1972) and by Eriksson and Ryvarden (1976).

The African collections are well-developed and similar in both macro and microscopical features to the specimens we have seen from Northern Europe.

Specimens: Africa. Kenya. Central Prov. Mt. Elgon, S of Suam River Valley to Kapchalwa Gate, alt. 2500-3100 m. 24 Jan. 1973. L. Ryvarden 9289 and 9320 (O).

MELZERODONTIA Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, arcte adnata, odontioides vel grandinioides, dura, aliquantum fragilis; systemate hyphali monomitico; hyphis basalibus arcte contiguis, sed distinctis, tenuitunicatis post crassiusculis; hyphis subhymenialibus leviter contiguis, hyphis omnibus sine fibulis, cyanophilis et dextrinoidibus; cystidiis nullis; in hymenio hyphae paraphysoideae ut videtur praesentes; basidiis clavatis, 4-sterigmatibus, basaliter valde dextrinoidibus; sporis levibus, tenuitunicatis, neque amyloidibus neque dextrinoidibus.

Typus generis: Melzerodontia aculeata Hjortst. & Ryv.

Fruitbody distinctly odontioid or when young grandinioid, with rather small aculei. Macromorphology similar to that of species in Hyphodontia. Hyphal system monomitic. Basal hyphae distinct, somewhat thick-walled and densely intertwined, subhymenial ones less thick-walled and agglutinated and in comparison with the basal hyphae much more dextrinoid, all hyphae without clamps. Cystidia lacking but apparently with some few paraphysoids (or dendrohyphidia). Basidia clavate, with basal part thickened, 4-sterigmated, both dextrinoid and cyanophilous. Spores thin-walled, subcylindrical in the known species, neither dextrinoid nor amyloid.

Remarks. This new genus is easily recognized by the presence of strongly dextrinoid hyphae, especially the subhymenial ones. Also the basidial base becomes brown in Melzer´s reagent. Furthermore it is well delimited by lacking clamps. In outer appearance the type species is somewhat similar to species in Hyphodontia, preferably H. verruculosa Erikss. & Hjortst. by its aculeate fructification. Since we have been unable to find a proper genus for the new species, we found it necessary to describe a new one.

MELZERODONTIA ACULEATA Hjortst. & Ryv. nov.spec.

Fructificatio resupinata, effusa, adnata, valde grandinioides vel odontioides; aculeis circiter 0.3 mm, levibus; colore infuscato; hyphis distinctis, tenuitunicatis post crassiusculis, sine fibulis, dextrinoidibus et cyanophilis, 2-3 um latis; cystidiis nullis, in hymenio hyphae paraphysoideae ut videtur praesentes; basidiis circiter 20 x 4-5 um, 4-sterigmatibus, basaliter crassiusculis, dextrinoidibus; sporis subcylindraceis, tenuitunicatis, 5-5.5(-6) x 2-2.5 um.

Holotypus: Africa.Tanzania. Tanga Prov.Tanga distr., Usambara Mts. Amani, alt. 800-1000 m. 18.-19. Febr. 1973. L. Ryvarden 10540 (O). Paratypus: do. Morogoro Prov. Morogoro distr., Uluguri Mts. Morning Side Res. sta. c. 5 km S. of Morogoro, alt. c. 1500 - 2100 m. 24.-26. Febr. 1973. L. Ryvarden 11074 (O).

Fruitbody resupinate, effuse, adnate, strongly grandinioid or odontioid with small aculei, less than 0.5 mm, nearly smooth, hymenium between the aculei somewhat cracked, in colour light brown, hard and somewhat brittle. Hyphal system monomitic, with basal hyphae distinct, somewhat thick-walled and with slight dextrinoid reaction, but strongly cyanophilous, subhymenial hyphae less thick-walled, usually strongly dextrinoid and cyanophilous, all hyphae ab. 2-3 um wide and without clamps. Cystidia lacking but a few paraphysoids (or dendrohyphidia) have been observed, slightly projecting above the basidia. Basidia clavate, thickened towards the base and basally dextrinoid and cyanophilous, 4-sterigmated, ab. 20 x 4-5 um. Spores smooth, subcylin-

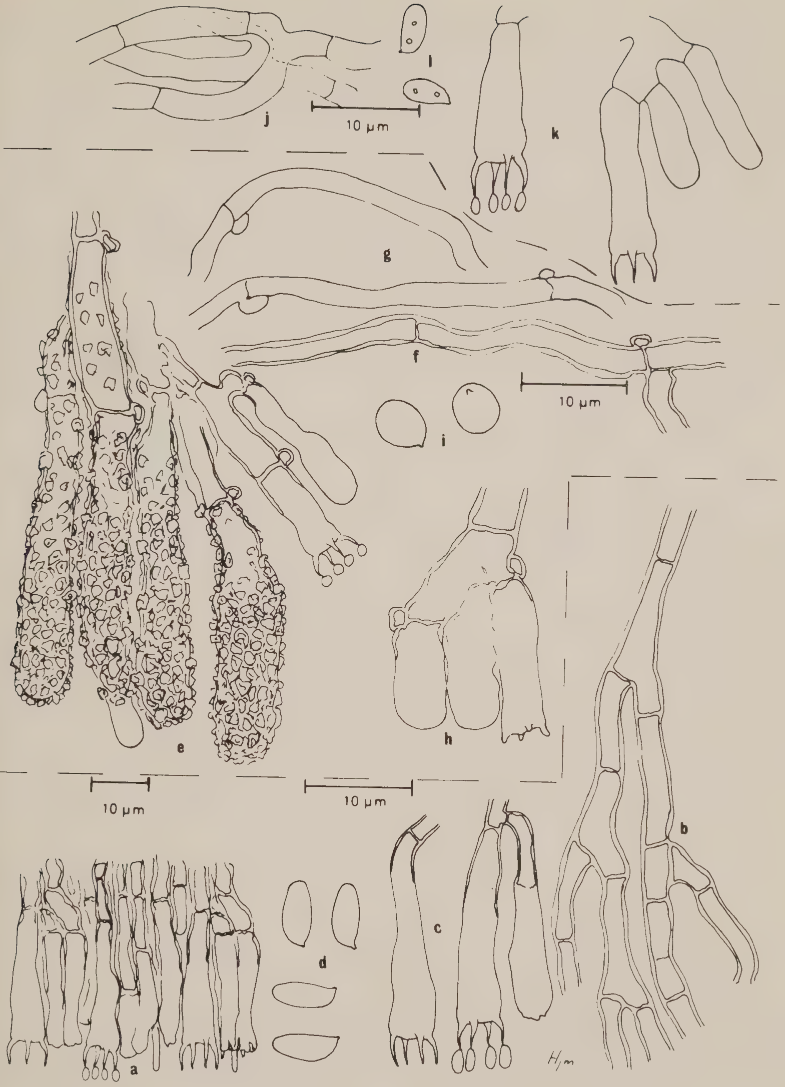
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Fig. 4. Melzerodontia aculeata, coll. Ryv. 10540. a) basidial layer b) hyphae c) basidia d) spores. Odontiopsis hyphodontina, coll. Ryv. 10949. e) projecting hyphae and basidia with immature spores f) basal hypha g) thin-walled hyphae h) young basidia i) spores. Phlebia verruculosa, coll. Ryv. 10859. j) hyphae k) basidia l) spores.

drical, thin-walled, 5-5.5(-6) x 2-2.5 um, neither amyloid nor dextrinoid or cyanophilous.

Remarks. Easily recognized by its aculeate fructification and dextrinoid hyphae and basidia base, and moreover without clamps and cystidia.

ODONTIOPSIS Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, adnata, distincte odontioides; aculeis fimbriatis; systemate hyphali monomitico vel subdimitico; hyphis basalibus plus minusve crassitunicatis, rectis, uniformibus, fibulatis; hyphis subhymenialibus tenuitunicatis vel crassiusculis, cellulis plus minusve brevibus, fibulatis; cystidiis nullis, in aculeis hyphoideis incrustatis dispositis; basidiis clavatis, brevibus, 4-sterigmatibus; sporis fere globosis, tenuitunicatis, levibus, non-amyloidibus.

Typus generis: Odontiopsis hyphodontina Hjortst. & Ryv.

Fruitbody resupinate, effuse, adnate, hymenium distinctly odontioid, with aculei more or less fimbriate; hyphal system monomitic or subdimitic. Hyphae of two kinds, subicular ones thick-walled and light-refracting in KOH and cotton-blue as well in Melzer´s reagent, long-celled and somewhat difficult to find clamps, subhymenial hyphae more thin-walled and less light-refracting, in a dense layer next to the basidia, swelling in KOH. Cystidia lacking. Projecting and encrusted hyphal ends numerous both on the aculei and in the hymenium between the aculei. Basidia somewhat stout, short and with 4 sterigmata. Spores thin-walled, smooth, more or less globose to rarely subglobose, non-amyloid.

Remarks. This new genus typified with O. hyphodontina has several characteristics which point to different odontioid or hydnoid genera. At first, the basal hyphae, which are strongly light-refracting, both in KOH and cotton-blue, and can possibly be taken for skeletals, point towards Schizopora Velen. The subhymenial hyphae, and especially the basidia-bearing ones as well as the appearance of the basidia are somewhat similar to Hyphodontia John Erikss. or Odonticium Parm. and also to Hyphodermella Erikss. & Ryv. It has also little in common with Radulodon Ryv. e.g. the spore morphology.
It seems to be necessary to give some of the mentioned genera a wider circumscription if this species should be incorporated and therefore we propose this new genus. We are of the opinion that the genus is easily recognized, primarely by its odontioid hymenium, projecting hyphal ends, and with short and somewhat stout basidia with nearly globose spores.

ODONTIOPSIS HYPHODONTINA Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata; hymenio odontioides, leviter ochraceo; aculeis fimbriatis, 6-8 per mm, 0.3-0.5 mm longis; systemate hyphali monomitico vel subdimitico; hyphis basalibus crassitunicatis, rectis, hyalinis, 3-4.5(-5) um, fibulatis; hyphis subhymenialibus tenuitunicatis vel crassiusculis, 4.5(-5) um, cellulis brevibus, fibulatis; cystidiis nullis, in hymenio hyphoideis incrustatis multis; basidiis fere subclavatis, circiter 12-15 x 5 um, 4-sterigmatibus; sporis levibus, tenuitunicatis, globosis vel raro subglobosis, (4-)4.5-5 um vel 5 x 4.5 um, non-amyloidibus.

Holotypus: Africa. Tanzania. Morogoro Prov. Morogoro distr., Uluguri Mts. Morning Side Res. sta. c. 5 km S of Morogoro, alt. 1500-2100 m. 24.-26. Febr. 1973. L. Ryvarden 10949 (O).

Fruitbody resupinate, effuse, adnate, when dry somewhat loosening from the substrate, irregularly odontioid, light ochraceous, aculei fimbriate, crowded, under a lens (50X) with projecting hyphae; margin in type collection indeterminable. Hyphal system monomitic or, depending on the thick-walled basal hyphae with long intervals, subdimitic. Basal hyphae refractive (in phase-contrast microscope), hyaline, in KOH up to 5 um wide, in cotton-blue mostly 3.5-4 um, with clamps. Subhymenial hyphae short-celled, slightly thickened or swelling in KOH, ab. 4.5(-5) um wide. Cystidia lacking, but with projecting and encrusted hyphae, especially at the tip of the aculei. Basidia short-clavate, mostly 12-15 x 5 um, with 4 sterigmata. Spores thin-walled, smooth, globose to rarely subglobose, in general 4-4.5 um or 5 x 4.5 um, non-amyloid.

Remarks. The species is easily recognized by its projecting hyphal ends and globose spores. A further diagnostic feature is the basidia-bearing hyphae, which are short-celled and somewhat swelling in KOH. It should be noted that the clamps on the subhymenial hyphae are difficult to observe, probably depending on the hyphal swelling in KOH or on age.

PHLEBIA Fr. Syst. Mycol. 1:426, 1821.

A large genus with a wide circumscription and seems to contain several taxa in the tropics. It will be treated later on together with other species from Africa.
Characteristics of species in Phlebia are in most species the tuberculate, merulioid or odontioid hymenium, in having ceraceous or subgelatinous consistency, usually horny when dry, narrow basidia in a dense palisade, and thin-walled spores of various appearance. Cystidia are commonly present, smooth or encrusted.

PHLEBIA VERRUCULOSA Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata, cremea vel ochracea, distincte granulata vel odontioides; aculeis parvis, 10-12 per mm, circiter 0.1 mm longis; margine indeterminato; systemate hyphali monomitico; hyphis tenuitunicatis, hyalinis, 3-3.5(-4) um latis, non-fibulatis; cystidiis nullis; basidiis anguste clavatis, 15-20 x 5 um, 4-sterigmatibus, basaliter non fibulatis; sporis ellipsoidibus vel subcylindraceis, hyalinis, tenuitunicatis, 4-4.5(-5) x 2-2.5 um, non-amyloidibus.

Holotypus: Africa. Tanzania. Tanga Prov. Lushoto distr., Usambara Mts., Magamba, c. 4 km N of Lushoto, alt. 1600-2000 m. 21.-22. Febr. 1973. L. Ryvarden 10859 (O).

Fruitbody resupinate, effuse, closely adnate, distinctly grandinioid to odontioid (under a lens 50X), mostly cream-coloured, margin similar, thinning out. Hyphal system monomitic, all hyphae thin-walled (swelling slightly in KOH), ab. 3-3.5(-4) um wide, without clamps, subhymenial hyphae dense and somewhat gelatinized in KOH. Cystidia lacking. Basidia narrowly clavate, ab. 15-20 x 5 um, with four sterigmata, no clamp at the basal septum. Spores ellipsoid or indistinctly subcylindrical, 4-4.5(-5) x 2-2.5 um, thin-walled, smooth and non-amyloid.

Remarks. Only known from one collection but well delimited from other species in the genus by its small spores, clampless hyphae and by its granular fructification. The species seems to be a member of the group of non-clamped Phlebias e.g. Ph. deflectens (Karst.) Ryv. and Ph. rosea (P.Henn.) Hjortst. & Ryv. In the first species scattered clamp connexions may occur but are difficult to find mainly due to the dense texture with the hyphae gelatinized in KOH. These characteristics are less pronounced in both Ph. rosea and Ph. verruculosa.

REPETOBASIDIUM John Erikss. Symb. Bot. Ups. 16(1):67, 1958.

The genus was described to accomodate species with basidial repetition and with fructification thin. Cystidia occur, spores are thin-walled, either globose to subglobose or allantoid, non-amyloid. All species seem to be rare or, as in many cases of the more or less inconspicuous species, overlooked.

REPETOBASIDIUM HASTATUM Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata, aliquantum tenuis, levis sed leviter pustuliformis, porulosa, in sicco plus minusve fragilis; colore albido vel fuscescenti; margine simili; systemate hyphali monomitico; hyphis basalibus distinctis, cellulis prolatis, circiter 3 um latis; hyphis subhymenialibus item distinctis, cellulis brevibus, tenuitunicatis vel crassiusculis, generatim 6-8 um latis; hyphis omnibus fibuligeris; cystidiis numerosis, lageniformibus, (50-)70-100 um longis; basidiis subglobosis vel subclavatis, cum repetitione, circiter 17 x 8 um, 4-sterigmatibus; sporis fere globosis, 6-7 um diametro, tenuitunicatis, neque amyloidibus neque cyanophilis.

Holotypus: Africa. Tanzania. Arusha Prov. Arusha Nat. Park. Lake Kusare-Ngurdoto Crater, alt. 1500-1700 m. 7.-9. Febr. 1973. L. Ryvarden 9951 (O).

Fruitbody resupinate, effuse, adnate, rather thin, more or less smooth but usually forming small pustules, porulose, fragile when dry, whitish, becoming light brown, margin similar. Hyphal system monomitic, subicular hyphae long-celled, straight, ab. 3 um wide, hyaline, subhymenial hyphae with walls thickened, commonly up to 6-8 um wide, short-celled,all hyphae with clamps, usually very small. Cystidia numerous, lageniform, with several adventitious septa, (50-) 70-100 um long. Basidia subglobose or subclavate, apparently with repetition, ab. 17 x 8 um, with 4 sterigmata. Spores nearly globose, 6-7 um in diam., thin-walled, not amyloid or cyanophilous.

Remarks. This species seems to be well defined by its subulate and lageniform cystidia, broad subhymenial hyphae and basidia with repetition. Furthermore, the spores are globose and very distinctive.
Though the new species is known from but one collection, it is very characteristic and it seems logical to place it in Repetobasidium. In general appearance and shape of the hyphae and basidia the species comes close to other species in the genus.

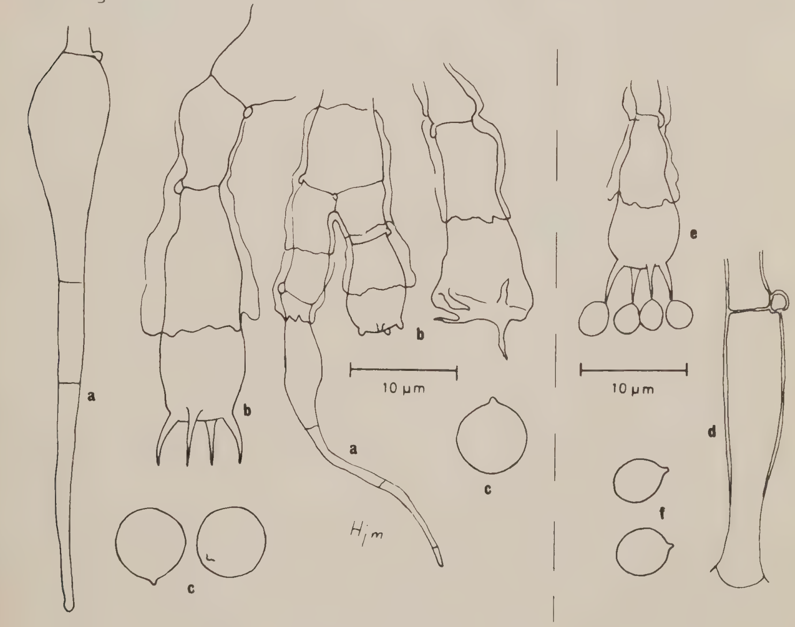

Fig. 5. Repetobasidium hastatum, coll. Ryv. 9951. a) cystidia b) basidia c) spores. R. mirificum, coll. Ryv. 10792. d) cystidium e) basidium f) spores.

REPETOBASIDIUM MIRIFICUM John Erikss. Symb. Bot. Ups. 16(1):70, 1958.

Specimen: Africa. Tanzania. Tanga Prov. Lushoto distr., Usambara Mts., Magamba c. 4 km N of Lushoto, alt. 1600-2000 m. 21.-22. Febr. 1973. L. Ryvarden 10792 (O).

Together with the preceding species the only known species in the genus from Africa. R. mirificum is new to the tropics and corresponds well with the Nordic material. The Tanzania-collection is well-developed, and the basidial repetition can easily be demonstrated. The species is a well-known taxon, especially from Northern Europe but is also reported by Oberwinkler (1965) from Central Europe (Bavaria).
Like other collections of corticiaceous fungi in the tropics, which are well-known from the temperate zone, there are always small differences in some characteristics, especially the spores size. The spores and often the basidia and hyphae also are either too small or somewhat larger than usual. This can be demonstrated also in the material of the reported species. The spores of R. mirificum in Nordic materials are usually more than 5 um across or subglobose 5-6 x 4.5-5.5 um, (cfr. the original description by John Eriksson), while Ryvarden's collection has spores 4.5 to rarely 5 um (in some cases up to 5.5um), besides they are also more regularly globose.

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CONTRIBUTION TO NEOTROPICAL CYPHELLACEOUS FUNGI - II.[1)]

DEIGLORIA GEN. NOV. (PHYSALACRIACEAE)

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Summary: The new genus *Deigloria* with four new species - *D. amoena*, *D. modesta*, *D. pulchella* and *D. pulcherrima* - is proposed; the relationship to the genus *Physalacria* as well as the deviations and similarities within the four species are discussed. *Physalacria subpeltata* is figured.

Zusammenfassung: Es wird die neue Gattung *Deigloria* mit vier neuen Arten vorgeschlagen - *D. amoena*, *D. modesta*, *D. pulchella* und *D. pulcherrima*; außerdem werden die Beziehungen zur Gattung *Physalacria* diskutiert. Die vier neuen Arten werden miteinander verglichen. *Physalacria subpeltata* wird abgebildet.

CORNER (1970) proposed the familiy *Physalacriaceae*, which SINGER (1975) rejects.[2)] Most characteristics of CORNER's family-diagnozis apply to the new genus *Deigloria*.

For the *Physalacriaceae* CORNER (1970) mentions subacerose young basidia. Two species of the new genus (*D. amoena* and *D. pulcherrima*) produce such subacerose basidioles. Another feature of the genus *Deigloria* are basidia with distinctly swollen apex and abruptly tapering sterigmata. In CORNER's figures of species of the genus *Physalacria*, however, such basidia are not drawn. However, they exist in the type species of *Physalacria* Pk. ss. Sing. sect. *Pileolina* Sing., i.e. in *P. subpeltata* Redhead (Fig. 1, and Redhead 1979).

Physalacria Pk. ss. Corner is well characterized by its

[1)] Contribution to Neotropical Cyphellaceous Fungi - I. Three New Species of *Flagelloscypha*. Mycologia 72 (5) : 908-915. 1980.

[2)] It is not the intention of the author to argue pro or contra the synonymization of Physalacriaceae with the Tricholomataceae as porposed by SINGER (1975).

fruit-bodies. They are stalked-capitate, ageotropic, with hollow, thinwalled heads and with a hymenium covering nearly the whole head (CORNER 1950:457). In *Hormomitaria* Corner (CORNER 1950:410), another genus of the *Physalacriaceae* (fide SINGER 1976: a synonym of *Physalacria* sect. *Hormomitaria*), the head is solid and positively geotropic. *P.* sect. *Pileolina*, however, possesses Discomycete-like heads with the hymenium on the discoid surface and with a sterile exterior. *P. subpeltata* grows in culture ageotropically (REDHEAD 1979); since this species was only found by incubating palm-leaves, it is not certain, whether the fungus grows in the same manner under natural conditions. Although CORNER in his generic description indicates that species of *Physalacria* Pk. ss. Corner have a hollow head, in *P. subpeltata* the head is not hollow. Although at the upper end of the stipe there are some short, inflated cells present (fig. 1c). Because of the flat and not hollowed or (cf. SINGER 1976:311) scarcely hollowed head of *P. subpeltata* SINGER proposed an own section for this species within the genus *Physalacria* Pk. ss. Singer.

In *Deigloria* the fruit-bodies are more of less cupshaped and sometimes with a small stipe; *D. pulchella* develops a hollow stipe and some inflated hyphae in the stipe.
The oleocystidia, which mark most species of *Physalacriaceae*, differ slightly in *P. subpeltata* from those of most other species of *Physalacria* ss. Corner and *Hormomitaria* Corner. In the species drawn by CORNER (1950), the oleocystidia have a rostrate apex or are merely clavate. SINGER (1976), however, characterizes some species of this group as having oleocystidia with broadened apices. In *P. subpeltata* the oleocystidia are distictly enlarged at the apex (fig. 1d, and REDHEAD 1979). In *Deigloria* the enlarged apex produces a whorl of mostly dichotomously branched excrescences (fig. 2,3,4,5). Also in *Deigloria* as well as in *P. subpeltata* (fig. 1 d) and species of the genus *Physalacria* ss. Corner the oleocystidia mostly produce an oily globule around the apex or on it. (CORNER 1950:462,464,465). In *Deigloria* and in *P. subpeltata* this drop of exudate is not wholly soluble in alkali as CORNER indicates for species of *Physalacria*.

Two species of *Deigloria* have typical oleocystidia in the hymenium but all species show them on the sterile face of of the cup (dermato-oleocystidia). In addition to these dermato-oleocystidia, another type of cystidium can be found (both types are called 'surface-hairs' in the terminology of the cyphellologist): the second type is more

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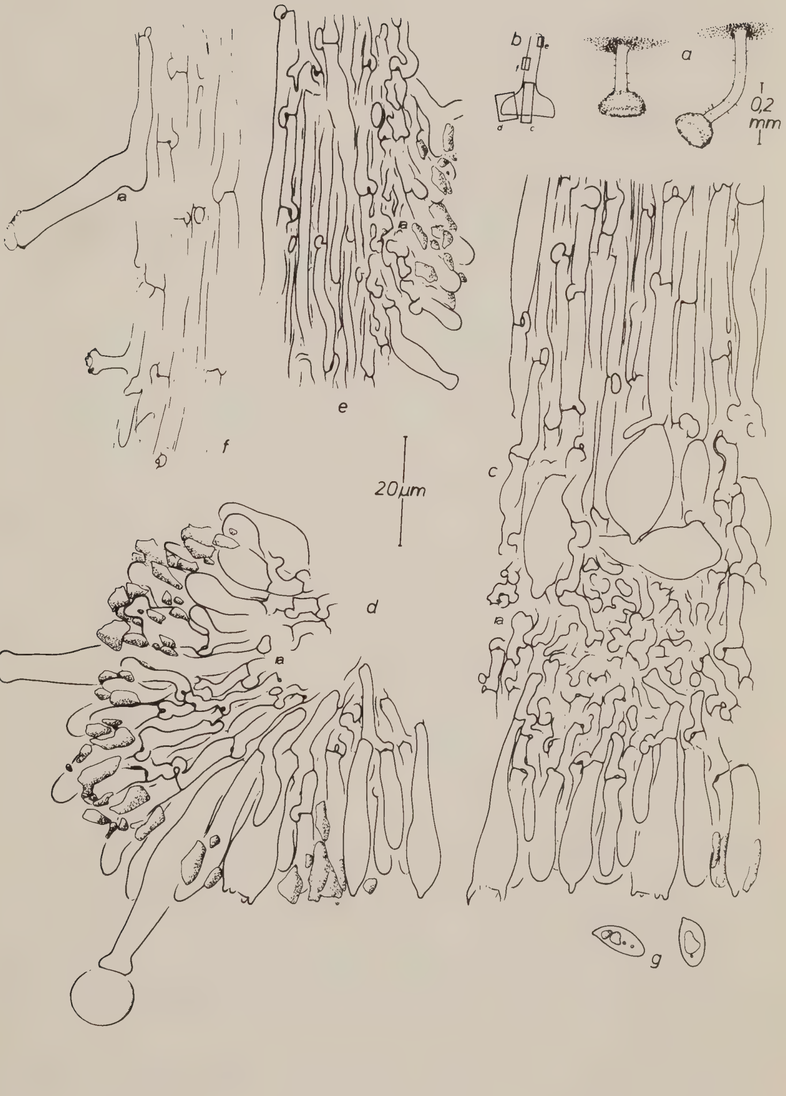
Fig. 1. *Physalacria subpeltata*. a. Habit of fruit-bodies. - b. Section through a fruit-body, survey. - c - f. Section through a fruit-body in detail, - c. central part of the hymenium with part of stipe, - d. edge, - e. surface of the base of the stipe, - f. surface of the middle of the stipe. - g. Spores. (All figs. from isotype, K).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or less clavate or of spherical form, rostrate or with few outgrowths (broom-cells). These cystidia are encrusted with brown exudate or with hyaline crystals probably calcium-oxalate. Similar cystidia but without encrustations are described by SINGER (1976:308) in the hymenium of *P. concinna* Sydow. Hyaline crystals are sometimes present in *Physalacria* Pk. ss. Corner (*P. aggregata* Martin & Baker, fide SINGER 1976:309), they are absent in *P. subpeltata* (fig. 1 and REDHEAD 1979).

In *Physalacria* Pk. ss. Corner the hyphae are monomitic and inflated, the hymenium does not thicken and the spores are hyaline, smooth and inamyloid; all these features hold true for *P. subpeltata* and *Deigloria* spp.; in *D. amoena* and *D. pulcherrima*, however, some spores are plasmatically brownish, closely resembling old spores of some species of *Physalacria* Pk. ss. Sing. (fide SINGER 1976:305).

Summaring the above mentioned characteristics, *Deigloria* differs from *Physalacria* Pk. ss. Corner, respectively *P.* sect. *Pileolina*, in some important features:

in cup-shaped fruit-bodies,
two types of surface-hairs (dermatocystidia) on the same fruit-body, and oleocystidia with a whorl-like apex.

MALENÇON & BERTAULT (1975:420) figured some oleocystidia of the species *Campanella conchata* (Kühn.) Sing. One of them seems to be similar to those of the genus *Deigloria*. The ontogeny of these cystidia, however, is deviating. Furthermore the shape of spores, the gelatinous trama, a special type of acanthocystidia, epimembranary pigment and gills with sterile edge separate this species from the genus *Deigloria*.

Therefore I propose to segregate this group of fungi in a genus on their own. Because of the striking oleocystidia the genus *Deigloria* is included in the family *Physalacriaceae* Corner.

DEIGLORIA AGERER gen. nov.[3]

Differt ab *Physalacria* cupulis patinaceis vel campaniformibus oleocystidiis verticillo appendicium plus minusve dichotome lobatarum.

Cupulae patinaceae vel campaniformes, solitariae, gibbis rubris. Pili externi duobus formis: forma una (dermato-oleocystidia) elongata, verticillo appendicium plus minusve dichotome lobatarum; verticillus globosa gutta exsudati ornatus. Forma alia (cellulae scopiformes) plus minusve clavata vel rostrata vel appendicibus tenuibus paucis, incrustata exsudato brunneolo et/vel crystallis hyalinis. Pili externi not dextinoidei, interdum plasmatici-brunneoli. Hyphae tramae non gelatinosae. Cystidia in hymenio praesentia vel absentia, praesentia formae primae pilorum externorum (dermato-oleocystidia) simila. Basidia maioribus capitibus sterigmaticis conicis abrupte contractis.

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[3] Etymology: Deus (lat.): God; gloria (lat.):glory.
Cui oculi, videat.

Sporae leves, hyalinae vel plasmatici-brunneolae, nec amyloideae nec dextrinoideae.

Typus generis: *Deigloria pulchella* Agerer.

Fruit-bodies solitary, cup- or bellshaped, with more or less densely crowded globular dark red or reddish-brown knobs. Two types of surface hairs: (1) (dermato-oleocystidia) elongated, with a whorl of nearly dichotomously lobed radiating excrescences bearing a globular drop of more or less reddish-brown exudate; (2) more or less clavate with a single beak-like or few slender outgrowths (broom-cells) encrusted with hyaline crystals and/or with brownish exudate; surface hairs non-dextrinoid; trama not gelatinous. Hymenium with or without cystidia. Basidia with a distinctly swollen apex, with conical, curved abruptly tapering sterigmata. Spores hyaline or plasmatically brownish, smooth, neither dextrinoid nor amyloid.

Type-species: *Deigloria pulchella* Agerer.

The macroscopical and microscopical characteristics of the up to now known species of the genus *Deigloria* are very conspicuous. In no description of neotropical species or others are characteristics like those of these four species mentioned.

KEY TO THE SPECIES OF DEIGLORIA

1 Hymenium with oleocystidia..2
  2 Fruit-bodies with a basal mycelial mat with red margin
                                        D. pulcherrima
  2 Fruit-bodies seated directly on the substrate
                                        D. amoena
1 Hymenium without oleocystidia.....................................3
  3 Dermato-oleocystidia crowded on the margin of the fruit-body, rare on the outer surface, second type of surface hair rostrate; spores subfalciform with a distinct beak
                                        D. modesta
  3 Dermato-oleocystidia more or less dense over the whole outer surface of the cup, absent on the stipe, second type of surface hair broom-cell-like; spores spindle-shaped
                                        D. pulchella

DEIGLORIA AMOENA AGERER spec. nov.[4]

Typus: Colombia, Dpto. Cundinamarca, Robledal, between km posts 16 - 17 from Mosquera, on the Mosquera - La Mesa Road, on indet. fern rachis, 8600 ft. Dumont & Idrobo, 21. 12. 1975 (Holotypus CO-2031 in NY).

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[4] Etymology: amoena (lat.): beautiful

Figure 2

Differt ab *D. pulchella* et *D. modesta* oleocystidiis in hymenio praesentibus, ab *D. pulcherrima* storea myceliale absente et cellulis scopiformibus in margine cupulae absentibus.

Cupulae asymmetrici-patinaceae vel asymmetrici-campaniformes, stipitatae, solitariae, usque ad 0.6 mm longae et in diametro, brunneolae, gibbis atro-sanguineis (in microscopio gibbae cupreae coloratae), storea mycelialis absens. Pili externi duobus formis: forma una (dermato-oleocystidia) 30 - 45 x 5 - 8 µm, verticillo appendicium dichotome lobatarum instructa; verticillus usque ad 20 µm in diametro, globosa gutta exsudati usque ad 20 µm in diametro ornatus; forma prima pilorum externorum subcrassitunicata (tunica usque ad 0.5 µm crassa), fibuligera. Forma alia (cellulae scopiformes) usque ad 25 x 10 µm, clavata, saepe substipitata, fibuligera, appendicibus 2 - 5, usque ad 7 µm longis et ca. 1 µm in diametro, incrustatis exsudato brunneolo; in margine cupularum non appendicibus instructa sed rostrata. Pili externi hyalini, interdum plasmatici-subbrunneoli. Hyphae tramae non agglutinatae, fibuligerae, 1.5 - 3.5 µm in diametro. Hymenium albidum, guttis exsudati atro-sanguinei exornatum (in microscopio exsudatum cupreum coloratum). Oleocystidia dermato-oleocystidia similia, 30 - 40 x 5 - 8 µm, fibuligera, verticillo usque ad 10 µm in diametro, gutta exsudati globosa, ad 10 µm in diametro ornato. Basidia maioribus capitibus, (28) 32 - 37 (40) x 7 - 8 (9) µm, fibuligera, 4-sterigmatica, sterigmatibus conicis abrupte contractis. Basidiola subacerosa praesentia. Sporae asymmetrici-ellipticae vel subnaviculares, interdum plasmatici-brunneolae, 10 - 11 x 4.5 - 5 µm, ca. 10.5 µm longae, proportio sporarum ca. 2.2; nec amyloideae nec dextrinoideae.

Fruit-bodies asymmetrically cup- or bellshaped, with a short stipe, solitary, up to 0.6 mm high and in diam., brownish coloured with garnet-red, globular knobs of exudate, without a basal mycelial mat. Two types of surface hairs: (1) (dermato-oleocystidia) 30 - 45 x 5 - 8 µm with a whorl of nearly dichotomously lobed radiating excrescences up to 20 µm in diam., apex with a globular drop of exudate up to 20 µm in diam., in transmitting light copper coloured; surface hairs slightly thickwalled, walls up to 0.5 µm thick, with clamps at the base; (2) (broom-cells) up to 25 - 10 µm, clavate, often with a small stipe, clamped at the base, the apex with 2 - 5 outgrowths up to 7 µm long and about 1 µm in diam., on the margin of the fruit-body only rostrate, encrusted with brownish exudate. Surface hairs sometimes slightly plasmatically brownish. Hyphae of the trama not agglutinated, 1.5 - 3.5 µm in diam., with clamps. Hymenium whitish with dark red globules of exudate. Oleocystidia with the same shape as the dermato-oleocystidia, 30 - 40 x 5 - 8 µm, whorl up to 10 µm in diam., with a globular drop of copper-coloured exudate, up to 10 µm in diam., with clamps at the base. Basidia with a

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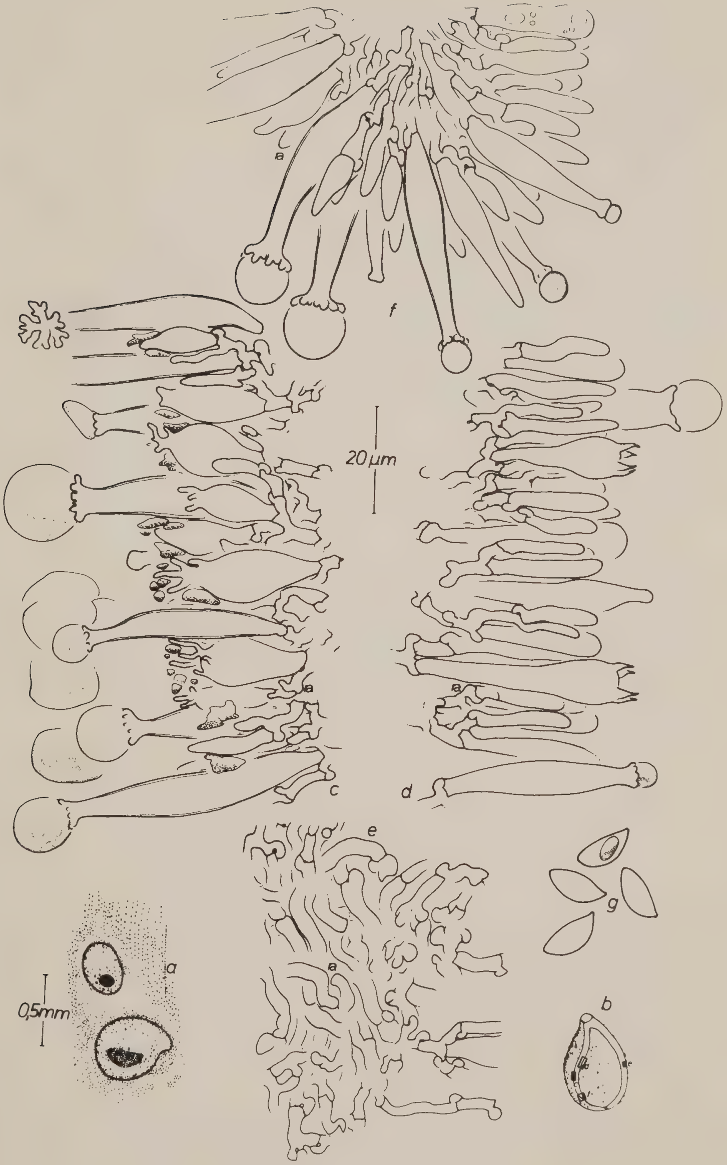
Fig. 2. *Deigloria amoena*. a. Habit of fruit-bodies. - b. Section through a fruit-body, survey. - c - f. Section through a fruit-body in detail, - c. outer surface from the middle, - d. hymenium from the midth, - f. trama from the middle, - f. edge. - g. Spores (All figs. from holotype CO-2031, NY).


a
f
20 µm
a
a
c
d
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a
g
a
0,5mm
b

distinctly swollen apex, (24) 30 - 35 (40) x 7 - 9 (10.5) µm 5) with four conical curved abruptly tapering sterigmata, clamped at the base. Basidioles subcerose. Spores asymmetrically ellipsoid to slightly naviculate, 10 - 12 (13) x 4.5 - 5.5 µm, hyaline or slightly plasmatically brownish, on the average 10.5 - 11.7 µm long, with sporefactor 2.1 - 2.3; neither amyloid nor dextrinoid.

Substrate: fern.

Discussion: Just as *Deigloria pulcherrima* develops oleocystidia in the hymenium so too does *D. amoena*. However, the oleocystidia are smaller and this species lacks the characteristically mycelial mat which *D. pulcherrima* (fig. 5b,e) exhibits; the second type of surface hair (broom-cells) seems to be somewhat bigger than those of *D. pulcherrima* (fig. 2c vs. 5d). Moreover the basidia of *D. pulcherrima* are smaller. Another difference is found on the margin of the fruit-bodies: *D. pulcherrima* develops typical broom-cells (fig. 5c) whereas *D. amoena* only develops rostrate cells (fig. 2f).

Further specimen examined: Colombia, Dpto. Valle del Cauca, ca. 83 km from Buga, on the Buga - Buenaventura Road, on indet. leaves (fern?), 380 m Dumont & Molina, 30. 8. 1976 (CO-7563 in NY).

DEIGLORIA MODESTA AGERER spec. nov. 6)

Typus: Colombia, Dpto. Chocó, on the Quibdó-Medellin Road, at a point ca. 155 km from the intersection with the Medellin - Ansermanuevo Road, ca. 1800 ft, on indet. fern leaf, Dumont, Carpenter & Sherwood, 10. 8. 1976 (Holotypus CO-6020 in NY).

Figure 3

Differt ab *D. amoena* et *D. pulcherrima* oleocystidiis in hymenio absentibus, ab *D. pulchella* cupulis non profundis, cellulis rostratis crystallis hyalinis incrustatis, stipite non excavato.

Cupulae subpatinaceae, stipitatae, solitariae, usque ad 0.3 mm longae et usque ad 0.6 mm in diametro, albidae, tomentosae, gibbis sanguineis ornatae in margine cupularum frequenter, extrinsecus rariter (in microscopio gibbae ochraceae coloratae); storea mycelialis absens. Pili externi duobus formis: forma una (dermato-oleocystidia) 28 - 48 x (5) 6.5 - 8 µm, verticillo appendicium dichotome lobatarum instructa; verticillus usque ad 10 µm in diametro, globosa gutta exsudati usque ad 15 µm in diametro ornatus; forma prima pilorum externorum paulo subcrassitunicata, fibuligera. Forma alia (cellulae rostratae) 15 - 28

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5) In the Latin diagnozis only the measurements of the type are described, in the English description all specimens are taken into account.

6) Etymology: modesta (lat.): modest

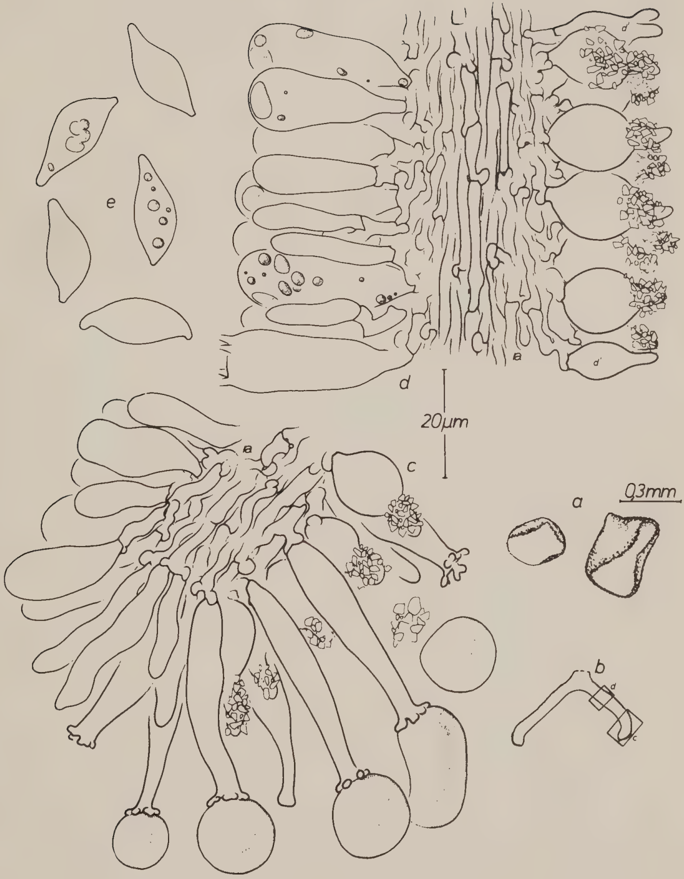
e
d'
a
d'
d
20µm
a
c
a
0,3mm
b
d
c

Fig. 3. *Deigloria modesta.* a. Habit of fruit-bodies. - b. Section through a fruit-body, survey. - c. Section through a fruit-body, detail of the middle. - e. Spores. (All figs. from holotype, CO-6020, NY).

x 6.5 - 11.5 µm, clavata, rostrata, fibuligera, interdum substipitata appendicibus 1 - 2, incrustatis crystallis hyalinis, in HCl rapide solventibus. Pili externi hyalini, interdum plasmatici-subbrunneoli. Hyphae tramae non agglutinatae, fibuligerae, (1.5) 2 - 3.5 (4.5) µm in diametro. Hymenium albidum, guttae exsudatae absentes. Basidia maioribus capitibus, 28 - 32 x 12 - 13 µm, fibuligera, 4-sterigmatica, sterigmatibus conicis abrupte contractis. Basidiola subacerosa absentia. Sporae subfalcisporae-similis vel subnaviculares, 16.5 - 20 x 7 - 8.5 µm hyalinae, ca. 18.5 µm longae; porportio sporarum ca. 2.4; nec amyloideae nec dextrinoideae.

Fruit-bodies shallow, cupshaped with distinct stipe, up to 0.3 mm high and 0.6 mm in diam., solitary, whitish with a reddish brown margin, finely hairy or pruinose, margin with crowded red globular knobs, however, rare on the outer surface, without a basal mycelial mat.
Two types of surface hairs: (1) (dermato-oleocystidia) 28 - 48 x (5) 6.5 - 8 µm, with a whorl of dichotomously lobed radiating excrescences up to 10 µm in diam., apex with a globular drop of exudate up to 15 µm in diam., in transmitting light reddish brown, slightly thickwalled, with clamps at the base. (2) (broom-cells) 15 - 28 x 6.5 - 11.5 µm, clavate with a rostrate apical end, clamped at the base, sometimes with a small stipe, encrusted with somewhat angular hyaline in hydrochloric acid rapidly dissolving crystals. Surface hairs not dextrinoid.
Hyphae of the trama not agglutinated, with clamps, (1.5) 2 - 3.5 (4.5) µm in diam.
Hymenium whitish, without oleocystidia and without red drops. Basidia with a swollen apex, 28 - 32 x 12 - 13 µm, with four sterigmata, clamped at the base. Without basidioles.
Spores subfalciform with a distinct beak, 15.5 - 19 (20) x (5.5) 6.5 - 8 (8.5) µm, hyaline, on the average 16.5 - 18.5 µm long, sporefactor about 2.4 - 2.6; neither amyloid nor dextrinoid.

Substrate: fern

Discussion: Both *Deigloria modesta* and *D. pulchella* lack hymenial oleocystidia, however, several characteristics distinguish *D. modesta* from *D. pulchella*.
The cupshaped fruit-bodies are shallow (fig. 3 a, b), those of *D. pulchella* are much deeper (fig. 4 a, b). The stipe of *D. pulchella* is hollow (fig. 4 b), that of *D. modesta* is solid (fig. 3b). The dermato-oleocystidia are crowded in *D. modesta* on the margin of the cup and are rare on the outside (fig. 3 c, d), in *D. pulchella* they grow more or less densely over the whole exterior (fig. 4 c, d). While the dermato-oleocystidia of both species correspond, the broom-cells deviate markedly: in *D. modesta* they are clavate with a rostrate apex and hyaline encrustations (fig. 3 d), in *D. pulchella* they possess a few thin excrescences and the cells are encrusted with brownish exudate (fig. 4 c, d), (hyaline crystals appear only on the stipe (fig. 4 f)); these outgrowths and the cells bearing them are thinwalled in *D. modesta* (fig. 3 d), but slightly thickwalled in

D. pulchella (fig. 4 c, d, f). The spores show apparent deviations too: the spores of *D. modesta* are subfalciform with a distinct beak (fig. 3 e) unlike those of *D. pulchella*, which are spindle-shaped (fig. 4 g).

Further specimen examined: Colombia, Dpto. Cundinamarca Vicinity km post 40 from Zipaquirá, on the Zipaquirá - Pacho Road, on indet. fern-rachis, ca. 2500 m, Dumont, Carpenter, Sherwood & Molina, 9. 6. 1976 (CO-4327, NY).

DEIGLORIA PULCHELLA AGERER spec. nov,. [7)]

Typus: Colombia, Dpto. Cundinamarca ca. 28 km from Mosquera, on the Mosquera - La Mesa Road, ca. 6000 ft., on indet. herbaceous stem, Dumont & Luteyn, 3. 1. 1976 (Holotypus CO-2051, NY).

Figure 4

Differt ab *D. amoena* et *D. pulcherrima* oleocystidiis in hymenio absentibus, ab *D. modesta* cupulis profundis et stipite excavato et cellulis scopiformibus.

Cupulae campaniformes, stipitatae, solitariae, usque ad 1 mm longae, brunneolae, gibbis atro-sanguineis (in microscopio gibbae subbrunneolae coloratae), storea mycelialis absens. Pili externi duobus formis: forma una (dermato-oleocystidia) 38 - 48 x 6 - 8 µm, verticillo appendicium dichotome lobatarum instructa; verticillus usque ad 10 µm in diametro, globosa gutta exsudati usque ad 15 µm in diametro ornatus; forma prima pilorum externorum crassitunicata (tunica usque ad 1 µm crassa), fibuligera, ex strato inferiore tramae oriens. Forma alia (cellulae scopiformes) 18 - 23 x 11 - 15 µm, subcrasssitunicata, clavata, interdum subglobosa, saepe substipitata, fibuligera, appendicibus 1 - 7, usque ad 10 µm longis et ca. 1 µm in diametro, incrustatis exsudato brunneolo; in stipitis tantum cellulae scopiformes praesentes, appendicibus usque ad 20 µm longis, incrustatis crystallis hyalinis angulatis, in HCl rapide solventibus. Pili externi hyalini, interdum plasmatici-brunneoli. Hyphae tramae subagglutinatae, fibuligerae, 2 - 4.5 (6) µm in diametro; hyphae stipitis tenere textae, usque ad 10 µm in diametro, in spatio inter hyphas crystallis hyalinis aggregatis, stipes in centro excavatus. Hymenium albidum, guttae exsudatae absentes. Basidia maioribus capitibus, 26.5 - 30.5 x (8) 10.5 - 12 µm, fibuligera, 4-sterigmatica, sterigmatibus conicis abrupte contractis. Basidiola subacerosa absentes. Sporae fusiformes, 16 - 17.5 (18.5) x 5.5 - 6.5 µm, hyalinae, ca. 17 µm longae, proportio sporarum ca. 2.8; nec amyloideae nec dextrinoideae.

Fruit-bodies bell-shaped with a distinct stipe, up to 1 mm high, solitary, surface warty, brownish with garnet-red globular knobs, without basal mycelial mat. Two types of surface hairs: (1) (dermato-oleocystidia) 38 - 48 x 6 - 8 µm, with a whorl up to 10 µm in diam. of dichotomously lobed radiating excrescences; apex with a globular drop of exudate up to 15 µm in diam., in transmitting light brownish,

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[7)] Etymology: pulchella (lat.): pretty thickwalled (with walls up to 1 µm thick), with clamps at the base, arising from a deeper tramal layer. (2) (broom-cells) 18 - 23 x 11 - 13 µm, with thick walls, clavate, sometimes almost globose; often with a small stipe, clamped at the base, the apex with 1 - 7 thickwalled outgrowths up to 10 µm long and about 1 µm in diam., encrusted with brownish exudate, on and in the stipe only with hyaline angular crystals rapidly dissolving in hydrochloric acid, the stipe only with broom-cells with outgrowths up to 20 µm long. Surface hairs not dextrinoid, sometimes plasmatically brownish, hyphae of the trama slightly agglutinated, with clamps, 2 - 4.5 (6) µm in diam.; hyphae of the stipe loosely woven, inflated, up to 10 µm in diam., with hyaline crystals in the interstices, stipe centrally hollow. Hymenium whitish, without oleocystidia and without exudate. Basidia with a swollen apex, 26.5 - 30.5 x 10.5 - 12 µm, four conical curved abruptly tapering sterigmata, clamped at the base. Without subacerose basidioles. Spores spindle-shaped 16 - 17.5 (18.5) x 5.5 - 6.5 µm, hyaline, on the average about 16.9 µm long, sporefactor about 2.8; neither amyloid nor dextrinoid.

Substrate: herbaceous stem

Discussion: The difference with *D. modesta* are discussed under that species.

DEIGLORIA PULCHERRIMA AGERER spec. nov. [8]

Typus: Colombia, Dpto. Cundinamarca, Road between Mosquera and La Mesa, W of Bogota, km 16, on fern, 2650 m, Oberwinkler, Dumont, Ryvarden & Buriticá, 8. 6. 1978 (Holotypus FO 26464, TUB).

Figure 5

Differt ab *D. modesta* et *D. pulchella* oleocystidiis in hymenio praesentibus, ab *D. amoena* storea myceliale et cellulis scopiformibus in marginis praesentibus.

Cupulae patinaceae vel campaniformes, non stipitatae, usque ad 0.8 mm longae et in diametro, sitae in storea myceliale margine sanguinea usque ad 0.4 mm in diametro; cupulae cineraceae, pulveraceae, gibbis atro-sanguineis (in microscopio gibbae ferrugineae coloratae), in margine nitide atro-sanguineae. Pili externi duobus formis: forma una (dermato-olecystidia) (25) 35 - 70 (120) x 6.5 - 10 (12) µm, verti-

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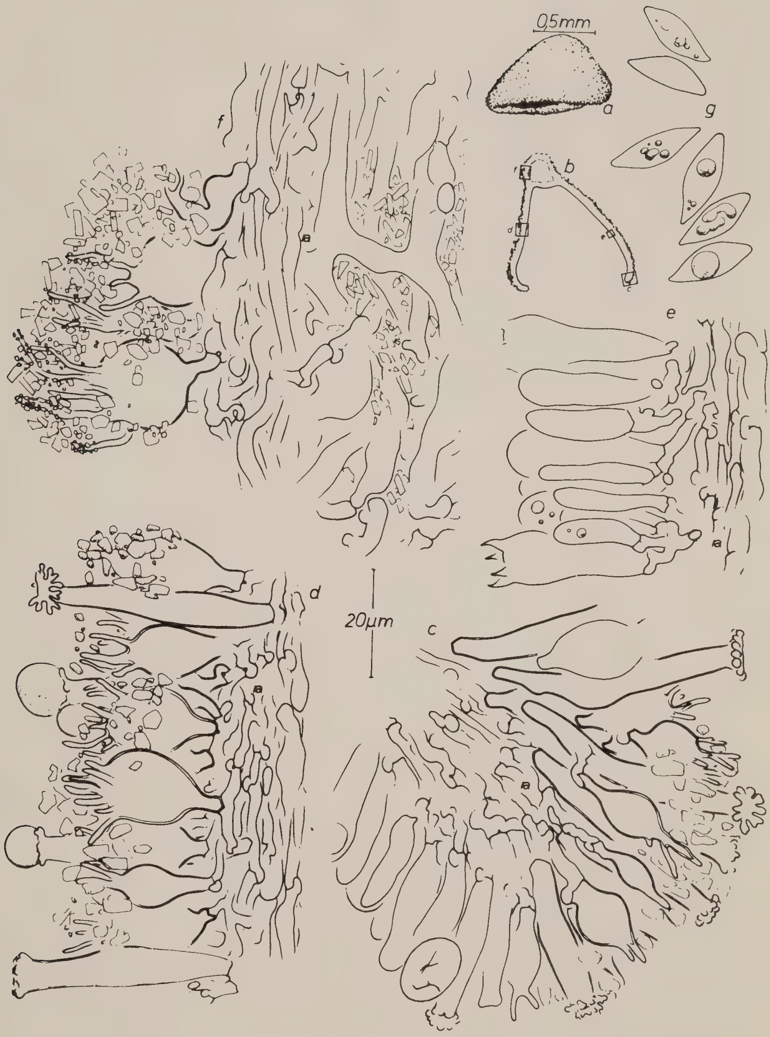
[8] Etymology: pulcherrima (lat.): magnificient

Fig. 4. *Deigloria pulchella*. - a. Habit of a fruit-body. - b. Section through a fruit-body, survey. - c - f. Sections through a fruit-body in detail, - c. edge - d. outer surface from the middle, - e. hymenium from the middle, - f. Wall of the stipe. - g. Spores. (All figs. from holotype, CO-2051, NY).


0,5mm
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20µm

cillus usque ad 20 µm in diametro, globosa gutta exsudati usque ad 30 µm in diametro ornatus; forma prima pilorum externorum subcrassitunicata (tunica usque ad 0.5 (1) µm crassa), fibuligera, ex strato inferiore tramae oriens. Forma alia (cellulae scopiformes) usque ad 18.5 x 16 µm, clavata, interdum subglobosa, saepe substipitata, fibuligera, appendicibus 1 - 6, usque ad 7 µm longis et ca. 1 µm in diametro, incrustatis exsudato brunneolo et crystallis hyalinis angulatis; crystalli hyalini frequenter extrinsecus cupulae. Utraeque formae pilorum externorum in storea myceliale sitae; margine storea mycelialis cellulae tunicis ochraceis, crassitunicatae, interdum verrucatae. Pili externi hyalini, interdum plasmatici-subbrunneoli. Hyphae tramae non agglutinatae, fibuligerae, 1.5 - 3.5 (6) µm in diametro. Hymenium albidum, guttis exsudati atro-sanguinei instructum (in microscopio gibbae ferrugineae coloratae). Oleocystidia dermato-oleocystidia similia, 40 - 70 x 6 - 12 µm, fibuligera, verticillo usque ad 16 µm in diametro, gutta exsudati globosa 30 µm in diametro ornato, ex strato inferiore tramae orientia. Basidia maioribus capitibus 23.5 - 26.5 (28) x 6 - 7 µm, fibuligera, 4-sterigmatica, sterigmatibus conicis abrupte contractis. Basidiola subacerosa praesentia. Sporae asymmetrici- ellipticae vel asymmetrici-ovoideae, 9.5 - 11.5 x 4 - 5 (5.5) µm, hyalinae vel saepe plasmatici-brunneolae, saepe in exsudato inclusae, ca. 10.5 µm longae, proportio sporarum ca. 2.3; nec amyloideae nec dextrinoideae.

Fruit-bodies cup- or bellshaped, stipeless, up to 0.8 mm high and in diam., sitting in a white mycelial mat, with a distinct red margin, up to 0.4 mm in diam.; surface greyish powdery with distinctly dark red-brown knobs, toward the margin dark reddish-brown and shiny. Two types of surface hairs: (1) (dermato-oleocystidia) (25) 35 - 70 (120) x 6.5 - 10 (12) µm, with a whorl of nearly dichotomously lobed radiating excrescences, apex up to 20 µm in diam. with a globular drop of exudate up to 30 µm in diam., in transmitting light reddish-brown, slightly thick-walled, (with walls up to 0.5 (1) µm thick, with clamps at the base, arising from a deeper tramal layer. (2) (broom-cells) up to 18.5 x 16 µm, clavate, sometimes almost globose, often with a small stipe, clamped at the base, the apex with 1 - 6 outgrowths up to 7 µm long and about 1 µm in diam., encrusted with brownish exudate or with slightly angular hyaline crystals found mostly in the middle of the outer surface of the fruit-body (causing the greyish tinge); two types of surface hairs present in the basal mycelial mat; the margin of the mat with cells exhibiting membranary brownish tinged walls (causing the reddish margin), thick walled, sometimes warty. Surface hairs sometimes plasmatically brownish. Hyphae of the trama not agglutinated, with clamps, 1.5 - 3.5 (6) µm in diam. Hymenium whitish

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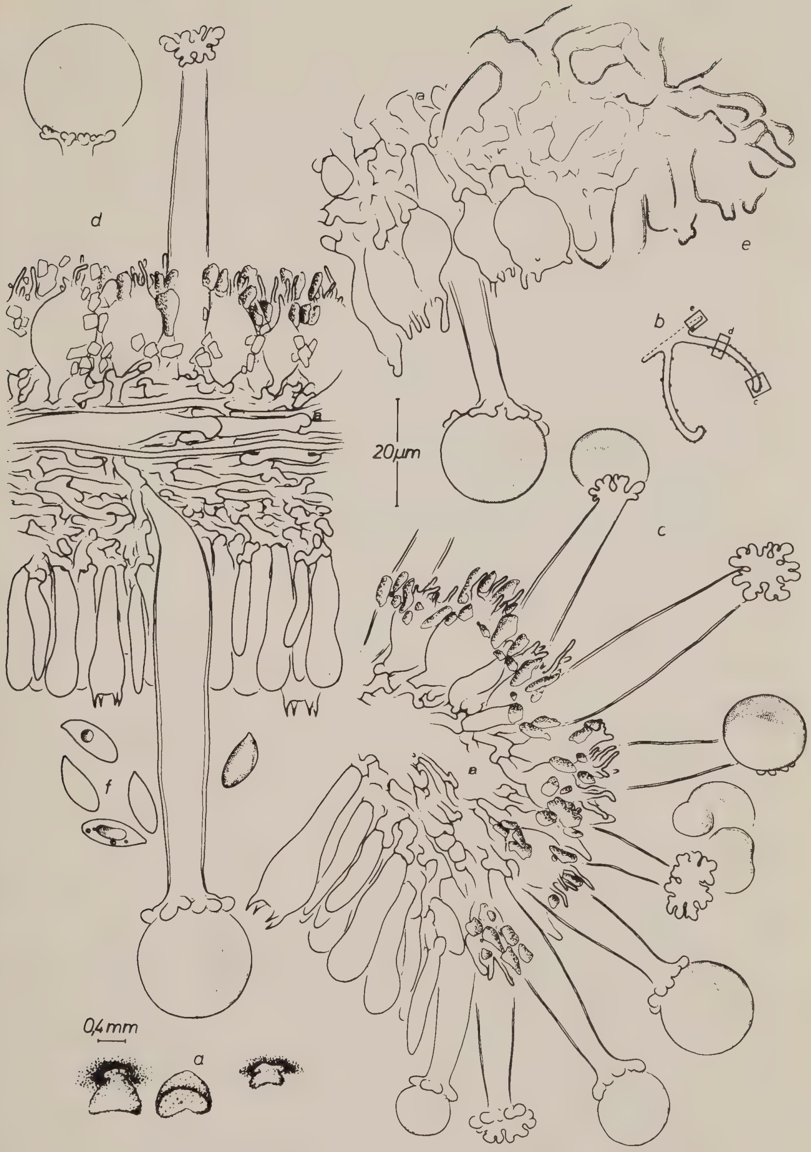
Fig. 5. *Deigloria pulcherrima*. - a. Habit of fruit-bodies. - b. Section through a fruit-body; survey. - c. Section through a fruit-body, detail of the edge. - d. Section through a fruit-body, detail from the middle. - e. Section through the basal mycelial mat of the fruit-body, detail of the edge. - f. Spores. (All figs. from holotype, FO 26464, TUB).


d
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with dark red globules. Oleocystidia with the same shape as the dermato-oleocystidia, 40 - 70 x 6 - 12 µm, whorl up to 16 µm in diam. with globular drop of reddish-brown exudate up to 30 µm in diam. arising from a deeper tramal layer, with clamps at the base. Basidia with swollen apex, 23.5 - 26.5 (28) x 6 - 7 µm, with four conical curved abruptly tapering sterigmata, clamped at the base. With subacerose basidioles. Spores asymmetrically ellipsoid to asymmetrically ovoid, 9.5 - 11.5 x 4 - 5 (5.5) µm, hyaline or mostly plasmatically brownish, often embedded in brownish exudate of the oleocystidia, on the average 10 - 11 µm long, sporefactor about 2.3; neither amyloid nor dextrinoid.

Substrate: fern

Discussion: The basal mycelial mat of *D. pulcherrima* is the best feature to distinguish it macroscopically from *D. amoena* (fig. 2 b vs. 4 b). Moreover *D. pulcherrima* possesses together with dermato-oleocystidia broom-cells almost up to the rim of the fruit-body (fig. 5 c), whereas *D. amoena* has in addition to the dermato-oleocystidia merely rostrate surface hairs on the rim of the cup (fig. 2 f). The mycelial mat differs well from a normal subicular layer (cf. Agerer 1973:416). Deviating from a subiculum this part of the fruit-body forms a definite border with differently shaped, coloured cells. This line can be seen under a lens as a more or less red rim around the white patch. Sometimes the marginal cells bear few warts and it seems that these cells are pigmented parietally. The other deviating microscopically features are discussed under *D. amoena*.

Further specimen examinded: Colombia, Dpto. Antioquia, Caldas of Medellin, forest above Hacienda Himalya, 1750 - 1800 m, Oberwinkler, Dumont & Ryvarden, 25. - 26. 6. 1978 (FO 27421, TUB).

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NOTES ON THE ORIGINAL SPECIES OF CERCOSPORINA

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Abstract

The history of *Cercosporina* Speg. and its typification is discussed. Based on the lectotype species *C. asparagicola* Speg. it becomes a later synonym of *Cercospora* Fres. Notes on the status and identity of the thirteen original *Cercosporina* species are provided.

The following study arose out of an attempt to determine the generic relationships of *Cercospora pachyderma* Syd., an unusual fungus with distoseptate hyaline cicatrized conidia that is incorrectly placed in *Cercospora*. The name was transferred to *Cercosporina* Speg. by Saccardo in Trotter (1931) but there has been some confusion over the nomenclatural and taxonomic status of this genus. The name *Cercosporina* was introduced by Spegazzini (1910) who at that time assigned thirteen species to it. None was designated as the type species. Subsequently more than one hundred species have been added to the genus although some were later removed to *Cercospora* Fres., *Cercosporidium* Earle or *Pseudocercospora* Speg. by different mycologists. On the whole *Cercosporina* has not been a fashionable genus and except for the sporadic description of new species, few recent additions have been made to it. Apart from its introduction by Spegazzini (1910) only Saccardo in Trotter (1931) and Miura (1928) have substantially enlarged the genus. On the other hand Clements & Shear (1931), Vassiljevsky & Karakulin (1937) and Chupp (1954) have regarded *Cercosporina* as a synonym of *Cercospora*.

The generic description ran 'Biogena foliicola caespitulosa; caespituli erumpentes ex hyphis olivaceis apice denticulatis simplicibus efformati; conidia vermicularia pluri-septata hyalina. Genus a *Cercosporella* hyphis olivaceis, a *Cercospora* conidiis hyalinis recedens.' By modern standards such criteria for distinguishing a genus in the Deuteromycotina are inadequate, for no information is given on conidiogenesis, conidiophore or conidial morphology. In the *Cercospora* complex it is particularly important to have details of conidiogenous loci, growth of the conidiogenous cells before and after conidial production and conidial pigmentation and scar production. It is therefore difficult to conceive what Spegazzini had in mind as characterizing his genus, particularly when his comment about its differences from *Cercospora* are taken into consideration. *Cercospora*, as typified by *C.apii* Fres., is known to have hyaline conidia, whereas Spegazzini distinguished his new genus *Cercosporina* from *Cercospora* because it had hyaline conidia! Chupp (1954) clearly exposed this error, and it is highlighted by the removal of *Cercospora apii* to *Cercosporina* by Miura (1928).

Clements & Shear (1931) listed *Cercosporina asparagicola* Speg. as the type species, presumably because this was the first one listed by Spegazzini in the genus. This should serve as the lectotype species unless there are cogent arguments against it. Clements & Shear (1931) provided no reasoning for their decision, and the generic diagnosis was sufficiently vague as to allow any one of the thirteen original taxa to be selected. Examination of Spegazzini's material shows that all but two of the original species are true *Cercospora* species. The implied lectotypification is accepted.

Vassiljevsky & Karakulin (1937) transferred the name *Cercosporina asparagicola* to *Cercospora*, and Chupp (1954) placed the name in synonymy with the well-known common species *Cercospora asparagi* Sacc. Both authors formally reduced *Cercosporina* to synonymy with *Cercospora*, a decision which is endorsed here as a result of the examination of Spegazzini's *Cercosporina* type collections. Consequently *Cercosporina* is not available to accommodate *Cercospora pachyderma* Syd. and alternative generic names must be examined before the species is satisfactorily placed.

Notes on Spegazzini's *Cercosporina* species

1) *C. asparagicola* Speg., *An. Mus. nac. B.Aires* 20: 424 (1910).

The type collection was in very poor condition and neither conidiophores nor conidia were found. The typical lesions, normally attributable to *Cercospora asparagi* Sacc. were present with immature caespitular stromata. The symptoms alone suggest that the synonymy proposed by Chupp (1954) and accepted by Viegas (1961) is correct. Spegazzini's illustration on the packet shows caespitulose, flexuose, nodulose conidiophores but no distinct scars. In fact the loci depicted are very similar to those found in *Pseudocercospora*. A single conidium was figured with a distinct thickened basal scar which is inconsistent with *Pseudocercospora*.

Accepted name:-

Cercospora asparagi Sacc., *Michelia* 1: 88 (1878).
Cercosporina asparagicola Speg., *ibid.*
Cercospora asparagicola (Speg.) Vassiljevsky apud Vassiljevsky & Karakulin, Fungi Imperfecti Parasitici. Pars.I. Hyphomycetes (Moscow): 296 (1937).

Material examined:-

On *Asparagus officinalis*, La Plata, Argentina, C. Spegazzini 4966, 6 May 1906, holotype *C. asparagicola* ex LPS (IMI 247001); Boyomo, Cuba, R. Urtiaga 954, 14 Sept. 1967, IMI 129568; Limuru, Kenya, N.K. Patel 3422, Nov. 1968, IMI 136463; *Asparagus plumosus*, Ho Chung, Hong Kong, R.I. Leather CB 438, 13 Dec. 1966, IMI 125811; Tafo, Ghana, S.J. Hughes 1354, 18 June 1949, IMI 39885; *Asparagus* sp., Limbe, Malawi, W.T.H. Peregrine SIB 250, 25 Mar. 1968, IMI 132447; Malawi, M.A. Siddiqui SIB 1076, 13 June 1970, IMI 149564; Brunei, W.T.H. Peregrine SIB 250, IMI 154080; Ruwa, Zimbabwe, A.Rothwell MR 25272, 13 Mar. 1974, IMI 183512; Salisbury, Zimbabwe, A. Rothwell MR 23885, 24 Jan. 1971, IMI 156389; Lusaka, Zambia, A. Angus M 1470, 16 Apr. 1962, IMI 95808; Ho Chung, Hong Kong, R.I. Leather CB 273, 28 June 1966, IMI 122024.

2) *C. caracallae* Speg., *An. Mus. nac. B. Aires* 20: 425 (1910).

The type showed hypophyllous caespituli and conidiophores 50-85 x 5-6 m that are very geniculate towards the apices with many thickened scars. The latter were figured clearly by Spegazzini in illustrations accompanying the material but not by Chupp (1954). Few conidia were present: they were comparatively short, hyaline, and with the typical basal thickened scar, and measured up to 50 m long x 3.5 m at the widest part.

This species is a good *Cercospora* and previous mycologists have arrived at the same conclusion. Vassiljevsky apud Vassiljevsky & Karakulin (1937), Greene (1944), Chupp and Viegas (1945) and again Chupp (1954) have each independently transferred the name to *Cercospora*. The conidiophores seem to be too short and closely geniculate for typical *C. canescens* Ell. & Mart. which is known from a wide host range within the Leguminosae, so for the moment the species is maintained as distinct.

Accepted name:-

Cercospora caracallae (Speg.) Vassiljevsky apud Vassiljevsky & Karakulin, Fungi Imperfecti Parasitici. Pars. I. Hyphomycetes (Moscow): 294 (1937).
Cercosporina caracallae Speg., *ibid.*
Cercospora caracallae (Speg.) Greene, *Trans. Wisc. Sci. Arts Lett.* 35: 132 (1944).
Cercospora caracallae (Speg.) Chupp apud Viegas, *Bol. Soc. Bras. agron.* 8: 15 (1945).
Cercospora caracallae (Speg.) Chupp, A Monograph of the Fungus Genus Cercospora: 289 (1954).

Material examined:-

On *Phaseolus caracalla*, Tucuman, Argentina, C. Spegazzini 4049, 14 Apr. 1906, holotype *C. caracallae* ex LPS (IMI 120631).

3) *C. daturicola* Speg., *An. Mus. nac. B. Aires* 20: 425 (1910).

The type was in poor condition and no intact conidia could be found. Nevertheless, the bases were thickened, each with a distinctive scar. Such pieces of conidia that were found corresponded with Spegazzini's illustrations accompanying the type packet. Conidiophores were much shorter, 35-50 m long, than in other conspecific material in herb.

IMI, and showed only 1-2 cicatrized scars.

The name was transferred to *Cercospora* by Vassiljevsky apud Vassiljevsky & Karakulin (1937) and later by Ray (1944) with *Cercospora abchazica* Siem. in synonymy. Chupp (1954) accepted the conclusions of Ray, but the latter did not examine the holotype and Chupp does not state whether he did or did not. Notes filed with material in herb. IMI by Mr. F.C. Deighton suggest that *C. daturicola* is scarcely distinct from either *C. apii* or *C. nicotianae* Ell. & Ev.

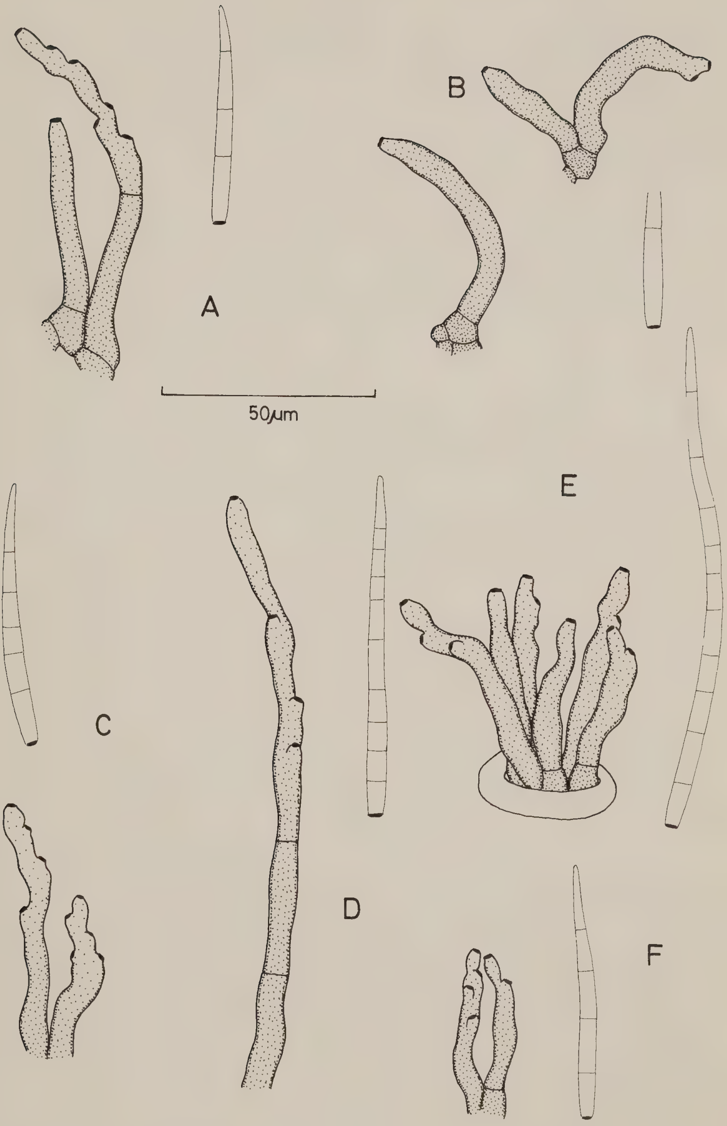
Accepted name:-

Cercospora daturicola (Speg.) Vassiljevsky apud Vassiljevsky & Karakulin, Fungi Imperfecti Parasitici. Pars. I. Hyphomycetes (Moscow): 347 (1937).
Cercosporina daturicola Speg., *ibid.*
Cercospora daturicola (Speg.) Ray, *Mycologia* 36: 175 (1944).

Material examined:-

On *Datura stramonium,* La Plata, Argentina, C. Spegazzini 12.774, Apr. 1904, holotype *C. daturicola* ex LPS (IMI 247003); Rajpur, India, Choudhury 13, Dec. 1967, IMI 132066; Kanpur, India, B.K. Singh, 18 Sept. 1963, IMI 103833 b; *Datura fatuosa,* Presidency Coll., Calcutta, India, M. Mandal C-1306, 15 Sept. 1967, IMI 136034; Mandalay, Burma, M. Thaung 4, 26

Fig. 1. A, *Cercospora caracallae* (IMI 120631), conidiophores and conidium; B, *C. daturicola* (IMI 247003), conidiophores and base of a broken conidium; C, *C. hydrangeae* (IMI 247005), conidiophores and conidium; D, *C. sphaeralceicola* (IMI 247011), conidiophore and conidium; E, *C. elongata* (IMI 247004), fascicle of conidiophores and conidium; F, *C. tetragoniae* (IMI 247013), conidiophores and conidium.


B
A
50µm
E
C
D
F

Nov. 1971, IMI 163008; *Datura suaveolens*, Ibadan, Nigeria, A.G. Bailey 407, 21 Nov. 1959, IMI 83825; Lusaka, Zambia, A. Angus M 1455, 15 Apr. 1962, IMI 95797a; *Datura* sp., Surya Binayak, Nepal, S.M. Shah 775, 13 Sept. 1967, IMI 132297.

4) *C. elongata* (Pk) Speg., *An. Mus. nac. B. Aires* 20: 425 (1910).

Conidiophores in the type were hypophyllous, fasciculate, short, up to 55 m long, with up to 3 cicatrized scars. Conidia were hyaline, filiform, 65-130 x 4-4.5 m, 3-8 septate, each with a thickened basal scar.

The species is a typical *Cercospora* and was accepted as such by Marchionatto (1946), Viegas (1961) and Chupp (1954) who suggested an enlarged synonymy, including *Cercosporina scabiosicola* (Rangel) Rangel (*Cercospora scabiosicola* Rangel), *Cercospora knautiae* Siem. and *C. dipsaci* Hollos.

Accepted name:-

Cercospora elongata Pk, *Ann. Rep. N.Y. St. Mus. Nat. Hist.* 33: 29 (1880).
Cercosporina elongata (Pk) Speg., *ibid.*

Material examined:-

On *Dipsacus sylvestris*, Jamesville, N.Y., U.S.A., holotype *C. elongata* ex NYS (IMI 247004); Columbus, Ohio, U.S.A., W.A. Kellerman, 25 July 1902, IMI 16358; *Dipsacus fullorum*, La Plata, Argentina, J.C. Lindquist 26316, 30 Mar. 1955, IMI 63156; *Dipsacus laciniatus*, Paltineni, Romania, O. Constaninescu, 27 July 1959, IMI 151108; Muntenia, Romania, T. Savulescu & C. Sandu, 29 Aug. 1931, IMI 8651 (*Herb. Myc. Rom.* fasci IX no 443); Moldova, Romania, T. Savulescu & C. Sandu, 28 Aug. 1933, IMI 8652 (*Herb. Myc. Rom.* fasc. XIV no 654).

5) *C. hydrangeicola* Speg., *Ann. Mus. nac. B. Aires* 20: 426 (1910).

The type collection from LPS was extremely meagre and poor, and the stromata found had only broken fascicles of conidiophores with no conidia. A later collection from the same locality (IMI 63155) is much better material and shows distinct leaf lesions, epiphyllous fascicles of conidiophores with cicatrized geniculate conidiogenous loci and hyaline filiform septate conidia each with a cicatrized scar at the base. This clearly places the fungus in *Cercospora* and Vassiljevsky apud Vassiljevsky & Karakulin (1937) actually transferred the name to this genus. Chupp (1954) placed the name as a synonym of *Cercospora hydrangeae* Ell. & Ev. and although he cited the type collection he did not state having seen it. The synonymy also included *Cercospora hydrangeana* Tharp and *C. arborescentis* Tehon & Daniels but Chupp did not give any explanation supporting his conclusions. *C. hydrangeana* had been transferred by Saccardo in Trotter (1931) to *Cercosporina*.

Accepted name pro tem:-

Cercospora hydrangeae Ell. & Ev., *J. Mycol.* 8: 71 (1902).

Cercosporina hydrangeicola Speg., *ibid.*

Cercospora hydrangeicola (Speg.) Vassiljevsky apud Vassiljevsky & Karakulin, Fungi Imperfecti Parasitici. Pars. I. Hyphomycetes (Moscow): 347 (1937).

Material examined:-

On *Hydrangea hortensis*, La Plata, Argentina, C. Spegazzini 4050, 8 May 1909, holotype *C. hydrangeicola* ex LPS (IMI 247005); La Plata, Argentina, J.C. Lindquist 13804, 9 May 1947, IMI 63155; Ho Chung, Hong Kong, R.I. Leather CB 75, 18 Feb. 1966, IMI 118490; *Hydrangea macrophylla*, Sabah, Malaysia, P.S.W. Liu PP 1319/60, 1973, IMI 175770; *Hydrangea opuloides*, Njala, Sierra Leone, F.C. Deighton M 665, 7 Dec. 1934, IMI 8441; Njala, Sierra Leone, F.C. Deighton M 2289, 17 May 1940, IMI 8442; *Hydrangea angustisepala*, Sozan, Formosa, W. Yamamoto, 3 Nov. 1933, IMI 8451; *Hydrangea* sp., Lake Gdns, Kuala Lumpur, Malaysia, A. Johnston 303, 18 Mar. 1949, IMI 35607; Brunei, W.T.H. Peregrine SIB 74, 1970, IMI 150101; Zimbabwe, A. Rothwell MR 12847,1955, IMI 59541; Ibadan, Nigeria, A.G. Bailey 513, 28 Apr. 1960, IMI 83818; N. Borneo, T.H. Williams PP 120/60, 1961, IMI 86630; Salisbury, Zimbabwe, A. Rothwell MR 18200, 15 Jan. 1963, IMI 98928c.

6) *C. jatrophicola* Speg., *Ann. Mus. nac. B. Aires* 20: 426 (1910).

No fungus corresponding to Spegazzini's description was found on the holotype collection, and since his illustration's on the packet neither show prominent cicatrized scars on the conidiophores nor on the bases of the conidia it is difficult to assess if this species belongs in *Cercospora* or one of its segregates.

Chupp (1954) transferred the name to *Cercospora* and kept the species distinct from *C. jatrophae* Atk. and *C. jatropharum* Speg., but he had not seen the holotype and therefore based his account on a specimen identified as the species from Texas, U.S.A. *Cercospora jatrophae-curcas* Yen has already been transferred to *Pseudocercospora*, and material in herb. IMI indicates that *C. jatropharum* belongs in the same genus. A true *Cercospora* on *Jatropha gossypiifolia* (IMI 149467) is known to occur in Venezuela so it is quite possible that Spegazzini's species may be either a *Cercospora* or a *Pseudocercospora*.

Material examined:-

On *Jatropha macrocarpa*, Tucuman, Argentina, C. Spegazzini 4766, 11 Apr. 1906, holotype *C. jatrophicola* ex LPS (IMI 247006).

7) *C. mate* Speg., *An. Mus. nac. B. Aires* 20: 426 (1910).

When Spegazzini introduced this name two collections were cited, one from San Ignacio by J. Torre and the other from Santa Ana by B. Zamboni. Torre's collection has been examined and infortunately no fungus corresponding to the Spegazzini account was found on it. Even though it is labelled 'Tipo' on the packet it seems inadvisable to select this a lectotype collection for the species. The Zamboni collection has not been seen but if it is fertile and corresponds to Spegazzini's account it would provide a suitable lectotype collection.

Spegazzini's illustrations in the packet show consistently curved conidia that are 2-3 septate, tapered towards the apices, apparently unthickened and not necessarily truncate at the bases. Conidiomata are pulvinate and superficial with simple conidiophores lacking geniculations and producing apical conidia. This fungus does not appear to be correctly placed in *Cercospora* but lack of more detailed information precludes a more confident identification. Marchionatto (1946) did not examine either syntype but transferred the name to *Cercospora* and maintained it separate from *Cercospora ilicicola* Maubl. (syn. *Cercosporina ilicicola* (Maubl.) Sacc.) which produces similar symptoms but larger conidiophores and conidia. Chupp (1954) also separated the species by differences in sizes of the stromata.

Until such time as the species is lectotypified the name remains of doubtful application.

Material examined:-
On *Ilex paraginayensis*, Misiones, San Agnacio, Argentina, J. Torre, July 1908, ex LPS (IMI 247007).

8) *C. physalidicola* Speg., *An. Mus. nac. B. Aires* 20: 427 (1910).

No mature conidia were found on the type, only long conidiophores which have 1-3 cicatrized scars and are geniculate in the way that true *Cercospora* species are known to be. Spegazzini's illustrations with the specimen show 2-4 septate conidia but with no noticeable scar at the base.

Vassiljevsky apud Vassiljevsky & Karakulin (1937) transferred the name of the species to *Cercospora* but in doing so made a later homonym of *C. physalidicola* Ell. & Barth. (as 'physalicola', Ellis & Bartholomew, 1896) and *C. physalidicola* Speg. (Spegazzini, 1899). *Cercospora physalidis* Ell. is accepted by Viegas (1946), Chupp (1954 and in herb. IMI as the name for the common species on *Physalis* which is of world-wide distribution. *Cercospora physalidicola* Ell. & Barth. was treated as a synonym by both authors. *Cercospora physalidis* Ell. was transferred to *Cercosporina* by both Spegazzini (1910) and Miura (1928) and distinguished from *Cercosporina physalidicola* by Spegazzini (1910) who considered all dimensions of the two species to be different. If *C. physalidicola* is indeed a true *Cercospora*, as seems likely, then it requires a new name because the epithet '*physalidicola*' is pre-empted in *Cercospora*. If it is not distinct from *C. physalidis* then it becomes a synonym of the latter name. A more complete type study is required to elucidate the position.

Material examined:-
On *Physalis viscosa*, Marmol, B. Aires, Argentina, C. Spegazzini 12517, 16 May 1905, holotype *C. physalidicola* ex LPS (IMI 247008).

9) *C. ricinella* (Sacc. & Berk.) Speg., *An. Mus. nac. B. Aires* 20: 429 (1910).

This species is well-documented by Chupp (1954) who accepted the fungus in *Cercospora* and suggested a synonymy based on type studies. *Cercospora ricini* Speg. and *C. albido-maculans* Wint. were included as synonyms. Chupp noted that the species was recorded from nearly every part of the world where the host is grown.

Examination of the type shows that the fungus is correctly placed in *Cercospora*.

Accepted name:-

Cercospora ricinella Sacc. & Berk., *Atti Ist. Ven. Sci. Lett. Art.* 3: 721 (1885).
Cercosporina ricinella (Sacc. & Berk.) Speg., *ibid.*

Material examined:-

On *Ricinus communis*, Logan, Qd, Australia, 1883, herb. B. Scortichini, holotype *C. ricinella* ex PAD (IMI 247009); 70 collections in IMI on *Ricinus communis* from Barbados, Haiti, Jamaica, Trinidad, Dominica, Cuba, Venezuela, Sudan, Ghana, Kenya, Nigeria, Zambia, Uganda, Malawi, Sierra Leone, Tanzania, Ethiopia, Yemen, Mauritius, Sri Lanka, India, Pakistan, Nepal, Papua New Guinea, Burma, Malaysia, New Caledonia, W. Samoa, Sarawak, Formosa.

10) *C. sensitivae* Speg., *An. Mus. nac. B. Aires* 20: 427 (1910).

The holotype did not bear any fungus corresponding to the original description. Spegazzini's illustrations on the packet show acicular, curved, guttulate, septate conidia lacking any definite scar at the base. The conidiophores are quite anomalous. Grouped in pulvinate masses, they are unequally 1 septate, the lower cell smaller than the upper one, obovoid and obtuse at the apex. Conidia are shown developing singly from the tips of the conidiophores. Such illustrations suggest that the species may be based on discordant elements, the described conidia belonging to one species and the conidiophores to another.

Chupp (1954) did not study the holotype, but, based on examination of a collection from Columbia which agreed with Spegazzini's account he transferred the name of the species to *Cercospora* and this was later accepted by Viegas (1961). In *C. pudicae* Yen (syn. *Ramularia mimosae* Stev. & Dalbey) the conidiophores are short and apparently similar to those in *C. sensitivae* but the species is a good *Cercospora* with cicatrized, geniculate scars, and had these been present in *C. sensitivae* Spegazzini would most surely have illustrated them.

It seems quite possible that the species is based on discordant elements but since the holotype is too poor to confirm this, the name is treated as a nomen dubium.

Material examined:-

On *Mimosa sensitiva*, Salta, Oran, Argentina, C. Spegazzini 12499, Jan. 1906, holotype of *C. sensitivae* ex LPS (IMI 247010).

11) *C. sphaeralceicola* Speg., *An. Mus. nac. B. Aires* 20: 427 (1910).

The holotype bore very little of the fungus but it was possible to confirm that the species belongs in *Cercospora*. Most conidiophores were effete but they showed cicatrized, geniculate scars typical of the genus. A single separate conidiophore measured 140 m long x 5 m wide, 1-2 septate and had 4 scars. One conidium was found. It was 78 x 4 m, 9 septate, hyaline, filiform, tapered to an acute apex and with a cicatrized scar at the base. Chupp (1954) transferred the name of the species to *Cercospora*. This was accepted by Viegas (1961) and confirmed in this study.

Accepted name:-

Cercospora sphaeralceicola (Speg.) Chupp, A Monograph of the Fungus Genus Cercospora: 377 (1954).
Cercosporina sphaeralceicola Speg., *ibid.*

Material examined:-

On *Sphaeralcea patagonica*, La Plata, Argentina, 5 Nov. 1904, C. Spegazzini 4051, holotype of *C. sphaeralceicola* ex LPS (IMI 247011).

12) *C. stenolobiicola* Speg., *An. Mus. nac. B. Aires* 20: 428 (1910).

No fungus corresponding to the original account was found on the holotype but Spegazzini's illustrations on the packet show long denticulate to geniculate olive brown conidiophores and hyaline, septate, guttulate conidia tapered to the apices. Neither conidiophores nor conidia are illustrated with cicatrized scars. This combination of features makes it difficult to place the species in either *Cercospora* or *Pseudocercospora*.

Chupp (1954) transferred the name of the species to *Cercospora* and although he does report having examined the type it is not clear if his description is based on that collection or others mentioned as originating from Argentina and Venezuela.

Of the similar fungi known on *Tecoma* (syn. *Stenolobium*) in herb. IMI, *Cercospora sordida* Sacc. has been transferred to *Pseudoseptoria* by Deighton (1976), *Cercospora tecomicola* Yen belongs more correctly in *Cercoseptoria* Petrak, and *Cercospora tecomae* Chupp & Viegas remains an acceptable species of *Cercospora*. If Chupp is correct in placing *C. stenolobiicola* in *Cercospora*, it must be very close indeed to *C. tecomae*, and if the two fungi prove to be the same then the epithet '*stenolobiicola*' has priority.

Accepted name:-

Cercospora stenolobiicola (Speg.) Chupp, A Monograph of the Fungus Genus Cercospora: 88 (1954).
Cercosporina stenolobiicola Speg., *ibid.*

Material examined:-

On *Stenolobium stans (≡Tecoma stans)*, Tucuman, Argentina, 13 Apr. 1906, C. Spegazzini 4045, holotype *C. stenolobiicola* ex LPS (IMI 247012).

13) *C. tetragoniae* Speg., *An. Mus. nac. B. Aires* 20: 429 (1910).

The type showed epiphyllous caespituli and fairly short conidiophores, up to 40 m long x 3.5-4 m wide, that are geniculate towards the apices with 2-4 cicatrized scars. The filiform hyaline, tapered conidia are 4-5 septate, each with a cicatrized basal scar. These observations are in accord with the original account and the illustration on the holotype packet and place the fungus in *Cercospora*.

The name of this species has been transferred separately to *Cercospora* by Vassiljevsky apud Vassiljevsky & Karakulin (1937), Chupp apud Viegas (1945) and Chupp (1954). Notes filed with material in herb. IMI by Mr. Deighton suggest that if this species is to be kept distinct from *C. apii* then *C. tetragoniae* is its correct name.

Accepted name:-

Cercospora tetragoniae (Speg.) Vassiljevsky apud Vassiljevsky & Karakulin, Fungi Imperfecti Parasitici. Pars. I. Hyphomycetes (Moscow): 221 (1937).
Cercosporina tetragoniae Speg., *ibid.*
Cercospora tetragoniae (Speg.) Chupp apud Viegas, *Bol. Soc. Bras. agron.* 8: 54 (1945).
Cercospora tetragoniae (Speg.) Chupp, A Monograph of the Fungus Genus Cercospora: 27 (1954).

Material examined:-

On *Tetragonia expansa*, La Plata, Argentina, C. Spegazzini 16153, 18 Nov. 1909, holotype *C. tetragoniae* ex LPS (IMI 247013); Brunei, W.T.H. Peregrine SIB 1016, 1972, IMI 167100; Njala, Sierra Leone, F.C. Deighton M 2715, 3 June 1949, IMI 37285; Cameron Highlands, Malaya, A. Johnston 372, 21 July 1949, IMI 37788; Lyamungu, Moshi, Tanzania, B.B. Wallace, Jan. 1945, IMI 1269; Nairobi, Kenya, R.M. Nattrass 1683, Dec. 1951, IMI 78907; Namalere, Kampala, Uganda, C.L.A. Leakey 00697, Apr. 1963, IMI 102828; Choma, Zambia, E.A. Riley 538, 18 Dec. 1954, IMI 59203.

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MYROTHECIUM TONGAENSE ANAM.-SP. NOV.

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ABSTRACT

Myrothecium tongaense anam.-sp. nov. is described from the calcified green alga *Halimeda* from Tonga.

INTRODUCTION

While visiting the island of Lifuka in the Kingdom of Tonga, one of us (B.K.) recently collected a dead thallus of a siphonaceous chlorophyte *Halimeda* sp. which bore conidiomata of a species of *Myrothecium*. Comparison with the other species of *Myrothecium* has shown it to be a new species.

TAXONOMIC PART

Tulloch (1972) accepted 13 anamorph-species in the anamorph-genus *Myrothecium* Tode ex Fries. The genus is characterized by setose or non-setose "....cupulate, sporodochial or synnematal...." conidiomata with a palisade of conidiophores terminating in a dense hymenium of "....hyaline or darkened...." phialides. The hymenium is often bordered by a slightly to strongly involute margin composed of branched, septate, straight or slightly coiled, smooth-walled to roughened, septate hyphae. The subhymenium may be either *textura intricata* or *textura porrecta* and may arise from a basal stroma of *textura angularis*. The hyaline to pale green conidia (dark green to black in mass) vary in shape from "ellipsoid" to "rod-shaped" and are either smooth-walled or may bear striations. In some species, the conidia bear mucilaginous apical appendages (Thompson & Simmens 1962, Tulloch 1972).

Species of Myrothecium have been recovered from soil (Barron 1968) and from many plant species (Tulloch 1972). This is the first report of a Myrothecium sp. occurring on an alga. We were able to isolate the fungus in pure culture; loosely organized but otherwise characteristic conidiomata develop after approximately 15 days at 24°C on PDA.

Myrothecium tongaense Kendrick, DiCosmo & Michaelides
anam.-sp. nov.

Hyphae immersae, ramosae, septatae, hyalinae, laevigatae, 2-3.5 µm lat.

Conidiomata sporodochia, dissita vel gregaria, irregularia, ebrunea, 60-300 µm lat. Margo involuta 10-15 µm lat., bene evoluta ex textura intricata orientes ex hyphae spirales convolutas ostendentes, ramosae, septatae, hyalinae, verruculosae. Subhymenium ex texturam porrectam hyalinis facientibus, mutatum versus partem fertilem in texturam intricatam; stroma basale non bene evolutis ex textura angularis orientes. Conidiophorae ex textura intracata orientes, ramosae, septatae, hyalinae, laevigatae, 80-100 x 2.5-3 (-3.5) µm. Cellulae conidiogenae phialides, subcylindricae, pallide viridi, verruculosae, 9-17 x 1.5-2.5 (-3) ($\bar{x}$=13x2) µm, colli bene evolutae. Conidia blastico-phialidica oblonga vel ellipsoidea, ad apicem truncata, ad basim decrescentia et truncata, 5-7 x 2(-2.5) ($\bar{x}$=6x2) µm; ratio mediano long./lat. = 3:1, in masse nigra.

Myrothecium tongaense Kendrick, DiCosmo & Michaelides
anam.-sp. nov. Figs. 1-10

Immersed mycelium composed of branched, septate, hyaline, smooth-walled hyphae 2-3.5 µm diam.

Figs. 1-10. Myrothecium tongaense. 1. Habit on Halimeda sp. x 5. 2. Conidiomata from rectangle in Fig. 1; arrow indicates fringe of marginal hyphae. X25. 3. Vertical section of conidioma. X300. 4. Tissue types of the conidioma. X480 (see text). 5. Detail of base of conidioma, arrowhead indicates the textura angularis. X1200.

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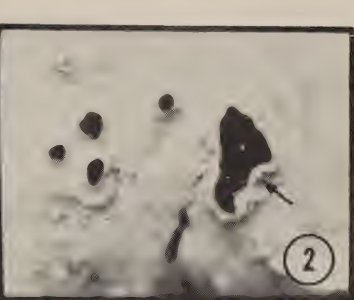
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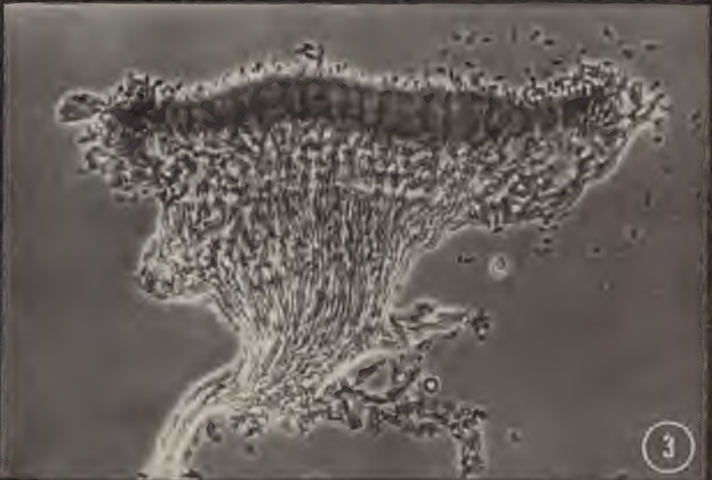
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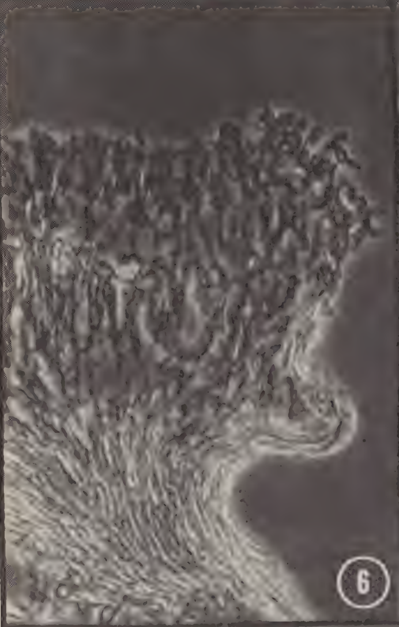
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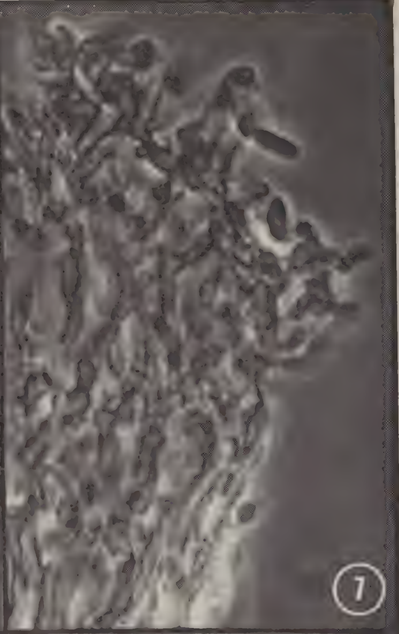
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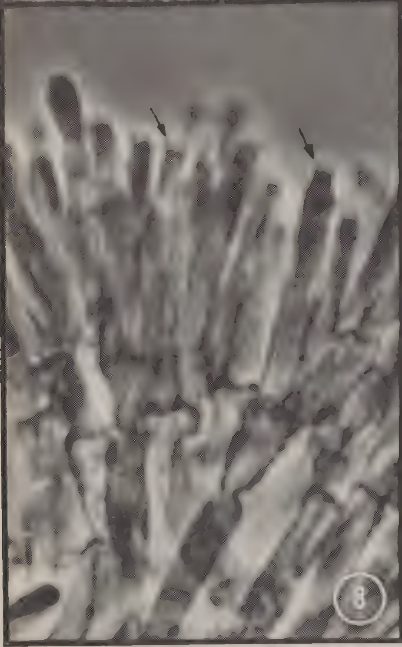
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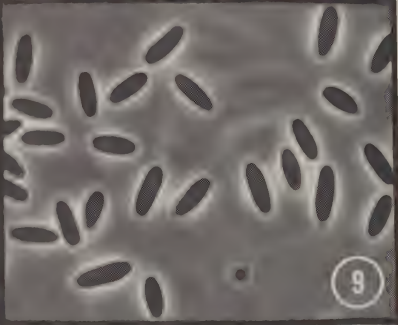
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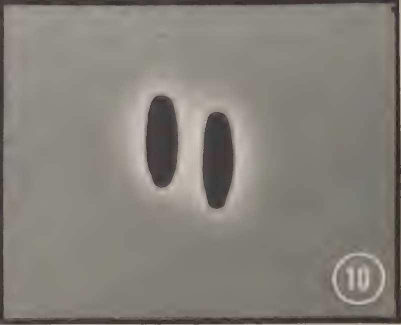
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Conidiomata sporodochial, scattered to gregarious, irregular in outline, 60-300 µm diam. Margin well developed, slightly involute, of _textura intricata_, 10-15 µm wide, composed of branched, septate, hyaline, verruculose, loosely coiled and twisted hyphae. Subhymenium of hyaline _textura intricata_ above becoming hyaline _textura porrecta_ below ultimately resting on a poorly developed basal stroma of _textura angularis_ (Figs. 3-5). Conidiophores arising from the subhymenium, branched, septate, hyaline, smooth-walled, 80-100 x 2.5-3 (-3.5) µm terminating in a dense conidial hymenium. Conidiogenous cells phialides, subcylindrical, pale green, verruculose, 9-17 x 1.5-2.5 (-3) ($\bar{x}$=13x2) µm, with a prominent collarette. Conidia blastic-phialidic, oblong-ellipsoid, apex truncate, base constricted and truncate, pale green, smooth-walled, 5-7 x 2(-2.5) ($\bar{x}$=6x2) µm, mean length/width ratio=3:1, collecting in blackish masses.

Habitat: on calcified portions of a dead thallus of _Halimeda_ sp.

Specimen examined: Holotype, DAOM 176764, B. Kendrick, Pangai, Lifuka, Ha´apai Group, Kingdom of Tonga, 1980-V-1; WAT, microscopic preparations derived from holotype; WAT, cultures on PDA and Sabouraud´s nutrient agar derived from conidial inoculations from holotype.

Myrothecium tongaense is similar in morphology to _M. cinctum_ (Corda) Sacc., _M. roridum_ Tode ex Fries and _M. verrucaria_ (Alb. & Schw.) Ditm. ex Fr., but easily distinguished from all three of these. The conidial walls of _M. tongaense_ lack the dark longitudinal striations characteristic of _M. cinctum_. Conidia of _M. tongaense_ also lack the mucilaginous apical appendage seen in _M. verrucaria_. _M. roridum_ is most similar to _M. tongaense_; however the "....rod shaped or narrowly ellipsoid, rarely slightly ovoid...." conidia (Tulloch 1972) of _M. roridum_ are easily distinguished from the oblong-ellipsoid conidia with truncate bases and apices of _M. tongaense_. In addition, the marginal hyphae of _M. roridum_ are smooth-walled, while those of _M. tongaense_ are verruculose.

Figs. 6-10. 6. Vertical section of conidioma X480. 7. Marginal hyphae. X1200. 8. Conidiogenous cells, arrows indicate collarettes. X2000. 9. Conidia. X1200. 10. Conidia X2000.

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NOTES ON *PSEUDOCOLUS FUSIFORMIS*

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Until recently, *Pseudocolus fusiformis* (Ed. Fischer) Lloyd has been encountered rarely, and then, only in few numbers. Blanton (1976) reported large numbers of basidiocarps in the Chapel Hill (Orange Co., North Carolina) area in the fall of 1975. Each successive fall in Chapel Hill, *P. fusiformis* has reappeared with an extended range and in greater numbers until the fall of 1979, when more than 1,000 sporocarps appeared. Such a large number of fruiting bodies collected in one location is not hitherto known from the literature. Previous descriptions of collections were based upon one to a few dozen specimens. The large number of fruiting bodies permitted a re-examination of measurements and characteristics of this stinkhorn. The taxonomy of the Phallales in general and the Clathraceae in particular is in a confused state because of the lack of specimens and developmental studies. Large fruitings such as this one provide the opportunity to study the variability in the species and, in this case, reaffirmed the reduction to synonymy of eight of the specific names suggested for the genus (Blanton, 1976; Burk, 1978). This paper compares the measurements of the latest collection to those described in the literature, extends the synonymy, expands the distribution, and discusses the ecology of *P. fusiformis*. Specimens are deposited in MICH, NCU and NY.*

In late September to October 1979, *P. fusiformis* appeared in several sites of the North Carolina Botanical Garden in Chapel Hill. A total of 940 basidiocarps and about 250 eggs were collected and preserved. Two hundred and fifty fresh, mature basidiocarps in excellent condition were measured to determine arm length, stipe length, and total length. In addition, the number of arms in the receptacle was noted and the ratio of arm to stipe length was calculated. Summary statistics of the basidiocarps' dimensions are presented in Table I, Part A. This collection will hereafter be referred to as the NC collection.

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*Abbreviations from: P.K. Holmgren & W. Keuken. Index herbariorum: Part 1, The herbaria of the world. 6th ed. Oosthoek, Scheltema & Holkema, Utrecht; 1974. vii, 397 p.

Table I. North Carolina Collection Measurements of *Pseudocolus fusiformis*

	Range	Mean	Standard Deviation
A. Basidiocarps (250 specimens)			
Total Length	32-90 mm	51.8 mm	± 10.2 mm
Stipe Length	3-31 mm	12.7 mm	± 4.9 mm
Arm Length	22-66 mm	39.2 mm	± 8.5 mm
Arm/Stipe Ratio	1-13	3.6	± 1.7
B. Spores (500 spores; 10 each from 50 specimens)			
Width	(1.08-)1.44-1.80(-2.16) µm	1.69 µm	± 0.18 µm
Length	(3.24-)3.60-4.32(-5.04) µm	4.00 µm	± 0.89 µm
Length/Width Ratio	(1.6-)1.8-3(-4.7)	2.4	± 0.13

Fertile glebal samples from fifty dried basidiocarps were mounted in water and examined with a 100X oil immersion objective. Ten spores from each sample were measured. The ratio of spore length to spore width was calculated. These measurements and calculations are summarized in Table I, Part B.

The first report of *P. fusiformis* (cited as *Colus fusiformis*) in the literature was by Eduard Fischer (1890). Since then there have been over 40 published papers reporting occurrences of this clathroid. The most significant of these reports are summarized in Table II. Table II includes the name used by the author (there have been 13 synonyms for *P. fusiformis*), the measurements (when cited) for number of arms, arm length, stipe length, total basidiocarp length, volva color and dimensions, and spore dimensions and cites the reference. Site of occurrence and the nature of the substrate are also included. This information is included here not only to compare the NC collection to those in the literature, but also to provide workers interested in the species with collection information that is often difficult to find.

Measurements from the NC collection as summarized in Table I did not differ significantly from those reported in the literature (Table II). *Pseudocolus fusiformis* has commonly been reported to have three arms and occasionally as many as six; of the 250 specimens counted from the NC collection 45 had four arms. The arm length to stipe length ratio is an interesting measurement since it has been cited to distinguish species in the genus (Cunningham, 1942). Clearly the ratio is variable from the arms and stipe being equal in length to the arms being 13 times as long as the stipe. Blanton (1976) reported specimens with a stipe longer than the arms. From the large NC population it is clear that this character is not valid for distinguishing species. The color of the arms in the NC collection was generally light reddish-orange. Recently, basidiocarps of this clathroid have been collected during the summer in Chapel Hill. These basidiocarps tended to be smaller and more intense reddish-orange.

Sporocarps of *P. fusiformis* usually bear three to four arms. However, in the fall of 1979, a small collection from a yard in Chapel Hill, NC, yielded two specimens with two arms (Fig. 1). The arms were united apically, but basally the stipe was reduced to a short collar of tissue. Anomalous fruiting bodies growing on bamboo in Japan were reported by Endo & Yokoyama (1935). A few specimens had five or six arms, while others had two stipes.

Spore measurements may also be highly variable. The NC collection spore dimensions are similar to those in the literature. Only *P. garciae* (Möll.) Lloyd has a lower limit spore width as narrow as that of the NC collection. The spores of *P. fusiformis* are most often cited as elliptical.

Table II. *Pseudocolus* in the literature

Name Used	Number of Arms	Length of Arms (mm)	Stipe Length (mm)	Total Length (mm)	Volva (mm)	Spores (um)	Substrate	Place and Date Collected	Reference
Anthurus javanicus (Penz.) G.H. Cunn.	3-4	20-30	6-25	18-65	white to pale brown, 14-18 X 7-11	3.5-4.5 X 1.5-2		Batavia, Goenoeng Salak, X/21; Priangan, Tjibodas, IV/30, Java	Boedijn 1932
	3-4		short	20-60	white, greyish, 15	3-4.5 X 1.5-2			Cunningham 1942
	3-(4)	25	20	45-53	dark grey, 15-20 X 13-14	3.5-5 X 1.2-1.7	soil in greenhouse under *Chaemerops humilis*	Prague, Czech., 26/III/58	Poner 1959
				16-50	15 X 12	3.0-4.5 X 1.5-2.0	leaf litter of oak forest, and slope in oak forest	near Vladivostok, U.S.S.R., 17/IX/51, 31/VII/54, & 4/VII/55	Sosin 1960
A. trifidus Harmand, Hariot & Patouillard	3	50						Japan	Harmond, Hariot & Patouillard 1902
Colus garciae Möll.	3			50	grey-white, 12(diam.)	5 X 1-1.5	on ground in shaded woodland, in humus	Garcia, Brazil, 30/X/92, XI/92, & I/93	Möller 1895
C. javanicus Penz.	3	25	20	45	dark brown			Tjibodas, Java, III/97	Penzig 1899
C. schellenbergiae Sumst.	(2)-3	17-68	6-37		white or dirty brown, 10-17(diam.)	4-5(5.5) X 1.5-2	rotten log rotten wood & humus	Summit, N.J., 27/VII/38; Ridley Park, Penn., 4/VIII/48	Coker & Rebell 1949
	3-4	27-52	7-32		white or dark brown, 20-28 X 14-20	3.5-4.5 X 2	soil with decaying material	Taipei, Taiwan, III/33	Sawada 1933
	3	30-60			dark brown, 20-30(diam.)	4.5-5.5 X 2-2.5	soil in yard	Pittsburgh, Penn., VII/15	Sumstine 1916

Pseudocolus fusiformis (Fisch.) Lloyd	3(-4)	(10)15-45(-50)	10-35	(25-)30-60(-70)	white to greyish white 5-25(diam.)	3.75-5 X 1.75-2.25	sawdust, soil, burned-over areas, & paths	Chapel Hill, N.C., Fall 1975	Blanton 1976
P. jaczewskii IU. Voronov	3	2-3 times longer than stipe	10-15		white, changing to greyish	4.7 X 2	ground under *Eucalyptus amygdalina* Lab. & in bamboo grove	South Colchis, U.S.S.R., 31/VIII/17	Voronov 1918
P. javanicus (Penz.) Lloyd	3	30	up to 15 beyond volva	15-47	brown, ovoid, 6-8(width)	4-5 X 2.5-3	on bamboo wood	Tirtasari, Tjinjiroean, Java, 1917	Bernard 1921a
	3-4		6-25	18-65	brown, sometimes almost white	4-5.5 X 15.-2.5	on rotting bamboo	Tjiater, Java, 18/XII/19	Bernard 1921b
	3-6				white, 35-43		on ground under bamboo	Miyazaki University (Japan), 27/IX/- 6/X/34	Endo & Yokoyama 1935
	3		1/2 total length including volva	40-50	white then becoming dark 10-15 X 10	3-4 X 1.5-2	ground in woods	Hahashima, Okimura-Kuwanokiyama, Japan, 18/XI/36	Ito & Imai 1937
	3	20			16 X 12	3.4-3.7 X 1.7-2.1	at trunk of *Nothofagus montana*	Tierra del Fuego, near Lago Fagnano, Argent., 19/II/50	Wright 1960
P. rothae (Fisch.) Lloyd	3	23-42	sometimes very short	40-60	white, globose	5 X 2	on organic soil in forest	Sendai, Honshu, Japan, 11/X/14 & 18/X/16	Yasuda 1916
P. schellenbergiae (Sumst.) Johnson	3(-6)		short, up to 65	45-70 (-80)	white, 15-20 X 10-15	4.5-5 X 2.2-2.5	in forest	Hokkaido, Honshu, Kyushu, Formosa, Sakhalin, Fall	Ito 1959
	3	25 (excluding volva)		55	17(height)		under tree	Nam-San, Seoul, S. Korea, 4/VI/39	Sato 1940

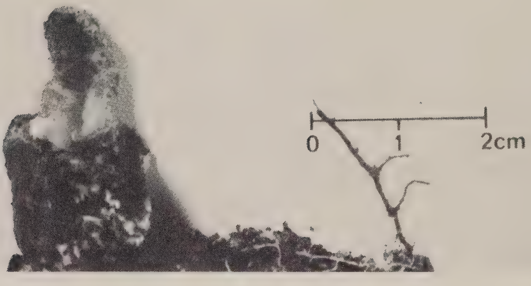

Figure 1. Two-armed specimen of *P. fusiformis.*

The NC fruiting of *P. fusiformis* occurred in three habitats: in the open on old woodchip mulch and thick grass, in a deciduous forest along paths on humus, and in the open in gardens on leaf mulch and humus. Most of the basidiocarps were collected from the open area where fruiting was caespitose. In the forest the basidiocarps were solitary to scattered, and in the garden solitary and very large.

Growing in association with the caespitose population on wood chip mulch was a large population of *Cyathus stercoreus* (Schw.) DeToni. Recently Flegler (1979) has successfully cultured *C. stercoreus*. Since both of these Gasteromycetes were found growing on the same substrate, it seemed possible that the *C. stercoreus* medium could be used to cultivate *P. fusiformis*. Attempts to maintain a tissue culture to start such a culture failed as did attempts to cultivate the mycelium in a crude soil culture.

Previous collections of *P. fusiformis* have been made in similar habitats and substrates to this NC collection, but during the summer as well as the fall. In Chapel Hill, this species was collected in July 1980, the first recorded summer occurrence. One basidiocarp appeared on an old, well-rotted tree stump about 30 cm off the ground. In 1977, Dr. L.F. Grand (personal communication) found eight three-armed specimens of *P. fusiformis* on rotted yellow poplar logs in Chatham Co., North Carolina. Table II summarizes the dates of occurrence, habitats, associations, and substrates of many of the reported *Pseudocolus* spp. fruitings.

Figure 2 shows the sites of occurrence of *P. fusiformis* as reported by Burk (1976, 1978). To the cited stations two should be added: North Vietnam [Kiet, 1975; cited as *Anthurus javanicus* (Penz.) G.H. Cunn.] and Alabama (Parker & Jenkins, 1979; cited as *Clathrus columnatus*).

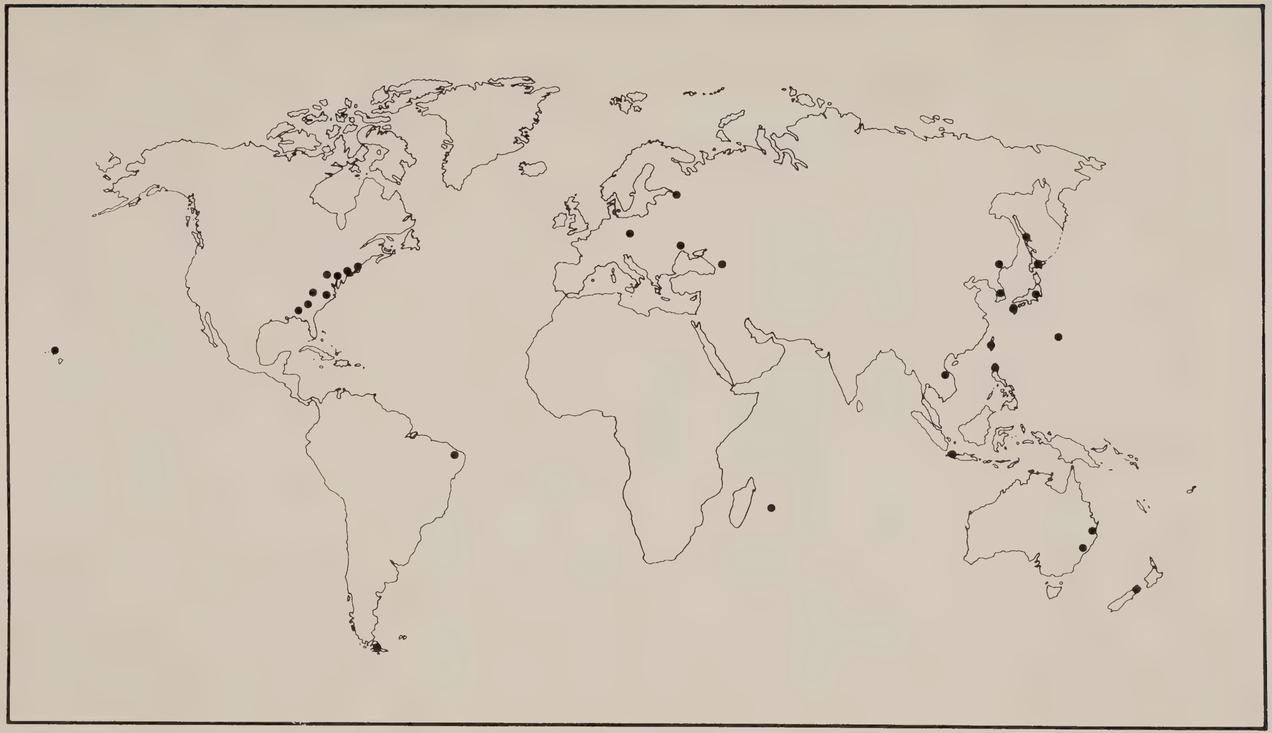

Figure 2. World Distribution of *Pseudocolus fusiformis*

To the synonyms listed by Blanton (1976) and Burk (1978) should be added:

= *Pseudocolus javanicus* f. *schellenbergiae* Ito & Imai, Trans. Sapporo Nat. Hist. Soc. 15: 3.

This name is reduced to synonymy based upon the literature description in which the authors stated that their form differs only in color from *Colus schellenbergiae* Sumst., a synonym of *P. fusiformis*. In this species color varies from yellow to orange-red; therefore the fact that part of the Ito and Imai population has maize-yellow arms does not justify the establishment of a new form.

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THREE NEW SECTIONS IN THE GENUS NAEMATOLOMA AND A DESCRIPTION OF A NEW TROPICAL SPECIES

by

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Naematoloma Karsten according to Singer (1975) has a subcellular hypodermiun with subglobose hyphae and usually chrysocystidia with a yellow or hyaline hyghly refractive amorphous central body (observed in KOH or NH_4OH solutions). The spores are generally subelliptic and melleous or yellowish brown.

Singer (1975) considered Psilocybe (Fr.) Kumm. different from Naematoloma because its hypodermium is not well differentiated and never subcellular, and chrysocystidia may or may not be present. Stropharia (Fr.) Quél. has chrysocystidia, but differs from Naematoloma in that it lacks a subcellular hypodermium and has an annulate stipe (Naematoloma is not annulate). Smith (1979) considered these three genera in Psilocybe sensu lato, following Quélet (1886) who considered Stropharia, Psilocybe and Naematoloma in the genera Geophila or Dryophila.

However in studying Psilocybe (a recently completed monograph) this author found the hypodermium subcellular in some species and with elongated hyphae in others. On the other hand, taking into consideration that Agaricus squamosus Pers. ex Fr., because it lacks of chrysocystidia, is considered by Orton (1969) to be a Psilocybe in spite of its subcellular hypodermium, and also taking in consideration that several species of Psilocybe without chrysocystidia have a subcellular hypodermium, e. g., P. hoogshagenii Heim, P. uxpanapensis Guzmán, P. subaeruginosa Clel., P. coprophila (Bull. ex Fr.) Kumm., and P. atrobrunnea (Lasch) Gill., this author considers that the structure of the hypodermium is not a valid character to separate Psilocybe from Naematoloma, but the presence or absence of chrysocystidia is a valid feature to separate both genera. Accordingly, Psilocybe lacks chrysocystidia, with or without a subcellular hypodermium; thus, all species of Psilocybe with chrysocystidia (Singer, 1975) are excluded.

Singer (1973; 1975) placed those species of Psilocybe with chrysocystidia in the Section *Chrysocystidiatae* Sing., of which *P. chrysocystidiata* Sing. is the type. But, this author has found that the type of *P. chrysocystidiata* from Bolivia (at BAFC) has typical chrysocystidia with a yellow inclusion, and it has small, subelliptic and pale brownish spores. The hypodermium is not subcellular and the habitat is lignicolous. Because of these features, this author considers the species a *Pholiota*, but since there is only one small specimen not so well preserved and without a spore print available, *Psilocybe chrysocystidiata* Sing. is considered a doubtful species.

In the present paper the genus *Naematoloma* is considered to be characterized by chrysocystidia (hyaline cystidia with hyaline, opaque or yellowish amorphous or striate granular contents, or yellow cystidia with opaque contents) and a subcellular hypodermium or a hypodermium with elongated hyphae.

Smith (1951) divided *Naematoloma* into only two sections· *Tenacia* and *Fascicularia*. Both have a subcellular, differentiated hypodermium, and yellow to orange-brown pigment incrusted hyphal walls. The chrysocystidia are common in all the species. Singer (1975) divided *Naematoloma* into four sections: Sect. *Naematoloma*, Sect. *Cyanoloma* Sing., Sect. *Stropholoma* Sing., and Sect. *Psilocybioides* Sing., of which Sect. *Stropholoma* Sing. is the only one without chrysocystidia. *N. squamosa* (Pers. ex Fr.) Sing. is the type species. This section corresponds to Orton's (1969) *Psilocybe* Sect. *Squamosae* Orton, with *Psilocybe squamosa* (Pers. ex Fr.) Orton as the type.

The Sections of *Naematoloma* accepted in this report are: Sect. *Naematoloma* (with *N. sublaterium* (Fr.) Karst. as the type), Sect. *Cyanoloma* Sing. (with *N. popperianum* Sing. as the type), and Sect. *Psilocyboides* Sing. (with *N. dispersum* Karst. as the type).

But in order to treat those species of *Psilocybe* with chrysocystidia in the genus *Naematoloma* three new sections in *Naematoloma*, two of them without a subcellular hypodermium, are described below.

Sect. *Neocaledoniae* Guzmán, sect. nov.

Chrysocystidiis, hypodermio subcelluloso vel hypharum parallele. Sporis rhombeis. Caerulescentes. Typus: *Naematoloma neocaledonica* (Guzmán & Horak) Guzmán.

Only two species are placed in this section:

Naematoloma neocaledonica (Guzmán & Horak) Guzmán, comb. nov., = *Psilocybe neocaledonica* Guzmán & Horak, Sydowia 31: 53, 1978. Species known only from New Caledonia (Guzmán & Horak, 1978).

Naematoloma naematoliformis (Guzmán) Guzmán, comb.

nov., = Psilocybe naematoliformis Guzmán, Beih. Sydowia 8: 172, 1979. Species known only from a tropical rain forest in southeastern Mexico (Guzmán, 1979).

Key to the species

1a. Hypodermium with elongate hyphae. Pleurocystidia 22-28 x 11-14.5 µm. Cheilocystidia 17-27 x 4-6.5 µm, usually not branched ________ N. neocaledonica

1b. Hypodermium with subglobose hyphae. Pleurocystidia 15-29 x 5.5-8.8 µm. Cheilocystidia 12-28 x 5.5-7.7 µm, usually branched irregularly ______ N. naematoliformis

Sect. Rhombisporae Guzmán, sect. nov.

Chrysocystidiis, hypodermio hypharum parallele. Sporis rhombeis parvis (-5 µm). Haud caerulecentes. Typus: Naematoloma rhombisporae Guzmán.

Only two species:

Naematoloma aequatoriae (Sing.) Guzmán, comb. nov., = Psilocybe aequatoriae Sing., Nov. Hedwigia 29: 59, 1978. Species known only from Ecuador (Singer, 1978) (see discussion of N. rhombispora Guzmán, below).

Naematoloma rhombispora Guzmán, sp. nov.

Pileus rufobrunneus brunneousque, 11-12 mm latus, campanulatus vel subpapillatus, pellucidus striatus, hygrophanus. Lammellis subadnates concolor pileo. Stipes 30-35 x 1 mm, fuscus apicem versus basin versus pallescens, fibrillis albis tectis. Sporis 3.8-4.4 (-4.9) x 3.3-3.8 x 2.7-3.3 µm, subrhombicis. Pleurocystidiis et cheilocystidiis 16.5-27.5 x 9-11 µm, globoso fusoideis vel fusoideo--vesiculosis. Hypodermium hypharum parallele, haud subcellularis. Ad terram vel ligno putrido in sylva subtropica, Mexico, Oaxaca, prope San Bartolome Ayautla, Leg. Jacobs 46 (Typus ENCB).

Pileus 11-12 mm in diam., campanulate to subpapillate, smooth but translucent striate at the margin when humid, reddish brown to brownish, hygrophanous, surface somewhat shiny, moist, not viscid. Lamellae subadnate to **slightly** decurrent, narrow and close, concolorous with pileus or near lilac-brown. Stipe 30-35 x 1 um, central, cylindric, hollow, somewhat flexuous, fibrous, brownish, covered with buff colored appressed fibrils, fuscous at the apex, darkening downward to bay colored. Context concolorous with the surface or somewhat paler.

Spores 3.8-4.4 (-4.9) x 3.3-3.8 x 2.7-3.3 µm, subrhombic in face view, subelliptic in side view, thick walled, brownish in KOH. Basidia 4-spored, hyaline. Pleurocystidia and cheilocystidia 16.5-27.5 x 9-11 µm, globose-fusoid to fusoid-vesiculose, hyaline or more frequently with opaque striate or granular contents, with thin or thick walls (up to 0.8 µm). Subhymenium subcellular, with orangish brown pigment incrusting the walls. Trama parallel, with hyaline to irregularly yellowish brown pigment on the walls. Epicutis with subgelatinous thin parallel hyaline hyphae. Hypodermium of hyaline to brown yellowish elongated hyphae, 5-14 um diam., more or less parallel to the surface. Clamp connections present.

Habitat. Gregarious on soil or rotten wood, in a coffee plantation in a subtropical forest at 800 m elevation.

Studied material. MEXICO: State of Oaxaca, near San Bartolome Ayautla, Jun. 20, 1978, J. Jacobs 46 (Type, ENCB).

A species close to *N. aequatoriae* (Sing.) Guzmán but differs in the pleurocystidia and cheilocystidia (see the key, below).

Key to the species

1a. Pleurocystidia and cheilocystidia similar in form, both hyaline to striate or granulose, 16.5-27 x 9-11 µm, globose-fusoid or fusoid-vesiculose, mucronate or not ______________________ *N. rhombispora*

1b. Pleurocystidia quite different in form from cheilocystidia, the former are vesiculose-ventricose, mucronate or not, the later are sinuate-obtuse or subampullaceous or cylindric or subclavate. Pleurocystidia with granular contents or with an amorphous internal body, 13-19 x 8-9 um. Cheilocystidia hyaline, 15-27 x 5-7.5 µm ______________________ *N. aequatoriae*

Sect. *Cokeriana* Guzmán, sect. nov.

Chrysocystidiis, hypodermio hypharum parallele. Sporis subellipsoidis. Haud caerulescentes. Typus *Naematoloma cokeriana* (Smith & Hesler) Guzmán.

Species considered in this Section are:

Naematoloma cokeriana (Smith & Hesler) Guzmán, comb. nov., = *Psilocybe cokeriana* Smith & Hesler, Jour. Elisha Mitchell Sc. Soc. 62: 193, 1946. The study of the type

(Hesler 3952 in MICH from U.S.A.) shows a fungus with chrysocystidia and a non-cellular hypodermium. Smith & Hesler (1946) related this species to *Naematoloma* but Singer (in Singer & Digilio, 1951) considered it as *Deconica cokeriana* (Smith & Hesler) Sing.

Naematoloma alnetorum (Sing.) Guzmán, comb. nov., = *Deconica alnetorum* Sing., Lilloa 25: 332, 1951. A species very close to *Naematoloma cokeriana* (Smith & Hesler) Guzmán. The type (Singer T-955 in BAFC from Argentina) shows a fungus with typical chrysocystidia and a hypodermium of parallel hyphae. Singer (1959) considered this fungus to be *Psilocybe alnetorum* (Sing.) Sing. Guzmán (1978) reported it from Ecuador.

Key to the species

1a. Spores (4.4-) 5.5-6.6 (-7.7) x 3.3-4.4 x 3.3-3.8 µm. Cheilocystidia lageniform *N. cokeriana*

1b. Spores (5.5-) 6.6-7.7 (-8.8) x 4.4-4.9 (-5.5) x 4-5 µm. Cheilocystidia ampullaceous *N. alnetorum*

Key to the Sections of the genus *Naematoloma*

1a. Spores rhombic 2

1b. Spores subelliptic 3

2a. Bluing species. Solitary or gregarious on soil or rotten wood. Hypodermium subcellular or with elongated hyphae Sect. *Neocaledoniae*

2b. **Species not blueing. Solitary or gregarious on soil or** rotten wood. Hypodermium with elongated hyphae Sect. *Rhombisporae*

3a. Bluing species. Solitary on soil. Hypodermium subcellular Sect. *Cyanoloma*

3b. **Species not blueing** 4

4a. Spores up to 10 µm long. Frequently on mosses. Hypodermium subcellular Sect. *Psilocyboides*

4b. Spores less than 10 µm long 5

5a. Hypodermium subcellular. Cespitose or fasciculate on wood (or if apparently on soil, the stipe has a pseudorhiza Sect. *Naematoloma*

5b. Hypodermium not subcellular. Solitary or subgregarious on wood or soil; stipe without pseudorhiza Sect. *Cokeriana*

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NOTES ON HYPHOMYCETES. XXXVIII. *SEPEDONIUM AMPULLOSPORUM* AND *SIBIRINA LUTEA* SP. NOV.

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ABSTRACT

Sepedonium ampullosporum Damon and *Sibirina lutea* Morgan-Jones and Gray, a new species, are described from collections made in North Carolina.

INTRODUCTION

In two previous papers in this series (Morgan-Jones and Gray, 1979; Gray and Morgan-Jones, 1980) fourteen species of mycoparasitic or fungicolous hyphomycetes that inhabit carpophores of higher fungi were described. Eleven of these had been collected in Alabama, of which four were new species. Exploration of this highly specialized ecological niche in North Carolina has yielded material of two further species. One, occurring commonly on boletes in the vicinity of Raleigh, has been determined to be *Sepedonium ampullosporum* Damon. The other, growing profusely over an aborted clavarioid carpophore, has proven to be yet another undescribed species of *Sibirina* Arnold [two new taxa were added to this genus by Gray and Morgan-Jones, 1980].

Since the original treatment of *Sepedonium ampullosporum* (Damon, 1952) is not entirely adequate by modern standards, description and illustration of it are provided herein together with the new *Sibirina*, for which the name *Sibirina lutea* Morgan-Jones and Gray is proposed.

TAXONOMIC PART

Sepedonium ampullosporum Damon, Mycologia 44: 91, 1952 (Fig. 1, Plate 1, A-E).

Colonies widely effuse, at first thin and white, then becoming somewhat floccose with age and turning golden yellow to orange as abundant chlamydospores are produced. Colonies on PDA thin, spreading rapidly (up to 25mm per 24h at 25°C), at first producing conidia of two types, followed by chlamydospores. Mycelium mostly superficial, partly immersed in the carpophore, composed of branched, cylindrical, flexuous, hyaline to pale yellow, smooth or verruculose when old, 3.5 - 5.5µm wide hyphae. Chlamydospores formed terminally on vegetative hyphae or laterally on short branches, solitary, dry, acrogenous, spherical, thick-walled, golden yellow, distinctly tuberculate, 15 - 20µm in diameter. Conidiophores polymorphic, micronematous or semimacronematous, straight or flexuous, hyaline, smooth or minutely echinulate or verruculose, hyaline, as unmodified attenuated terminal elements of hyphae or of lateral branches; or branched, candelabra-like, bearing terminal groups of two or three conidiogenous cells. Conidiogenous cells monophialidic, polymorphic, long cylindrical and attenuating gradually towards the apex, 32 - 35 X 3 - 3.5 µm; or, if in groups, short, more or less cylindrical, attenuating very slightly towards the apex, 20 - 35 X 3 -4 µm. Conidia enteroblastic, produced at the tips of the phialides, polymorphic, hyaline, smooth, non-septate; those produced on candelabra-like conidiophores ovate, distinctly papillate at the apex, subtruncate at the base, 19 - 20 X 5 - 6µm wide in the broadest part; those produced on undifferentiated conidiophores narrowly ellipsoid, obtuse at each end, 16 - 24 X 5.5 - 6µm.

On carpophores of Basidiomycetes; Europe, Japan, North and South America.

Collection examined: on *Boletus* sp., Raleigh, Wake County, North Carolina, September 20, 1979, D.J. Gray, AUA.

S. ampullosporum can be distinguished from *S. mycophilum* (Pers) Nees, the type species of *Sepedonium* Link, in several respects.

The wall projections which give the chlamydospores their tuberculate appearance are appreciably larger and more variable in shape and size in *S. ampullosporum* than in *S. mycophilum* (Plate 1E-F), [*S. mycophilum* collection on *Boletus* sp., Auburn, Lee County, Alabama, August 11, 1977, G. Morgan-Jones, AUA]. They are also more widely and less evenly spaced in *S. ampullosporum*.

The conidial elements of the two species also differ significantly. There is no polymorphic conidial condition in *S. mycophilum* equivalent to that of *S. ampullosporum* and the morphology of the papillate conidia of the latter is distinctive.

Studies of conidiogenesis in culture chambers modified

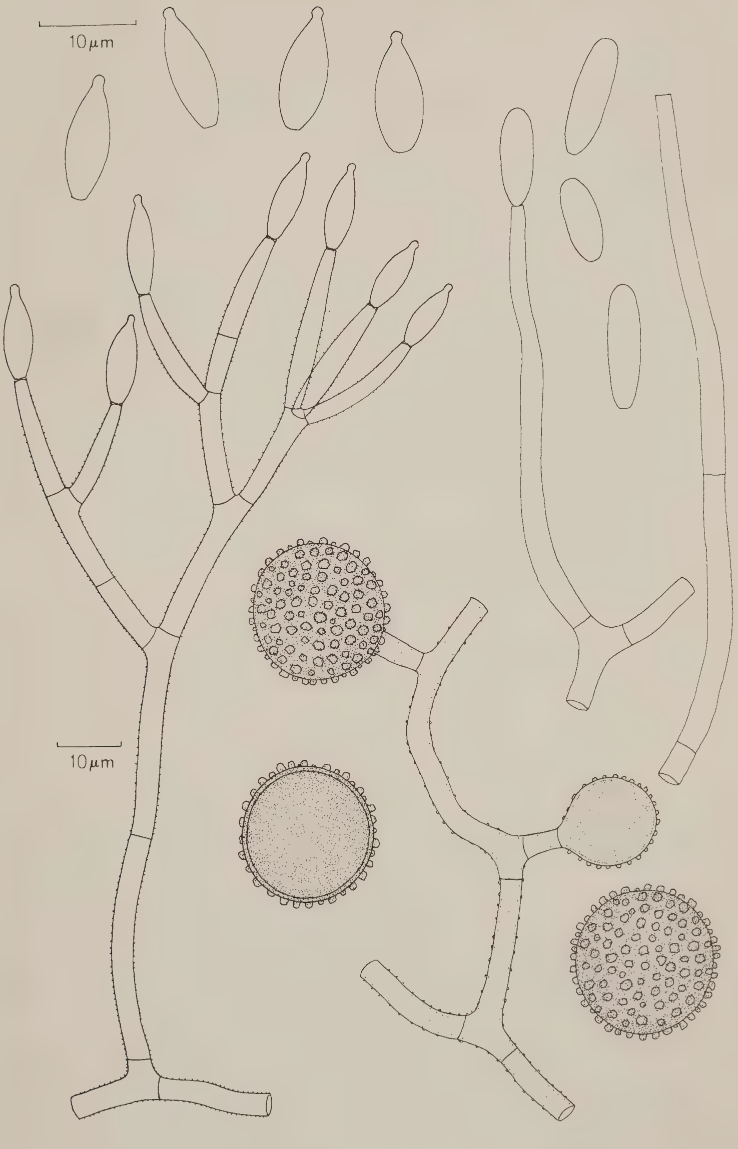


FIGURE 1. *Sepedonium ampullosporum*

after Cole et al. (1969) have indicated that the papillate conidia are produced singly and solitarily from each of their respective conidiogenous cells and are rather slow developing. During the time taken for one such conidium to be produced and mature, up to four conidia of the ellipsoid type are produced from a single conidiogenous cell. Both types of conidia are produced simultaneously in culture chambers; chlamydospore production follows. Damon (1952) suggested that conditions of low moisture were favourable for the production of the papillate type whereas conditions of high relative humidity favoured the production of the ellipsoid type. Our studies have not confirmed this distinction.

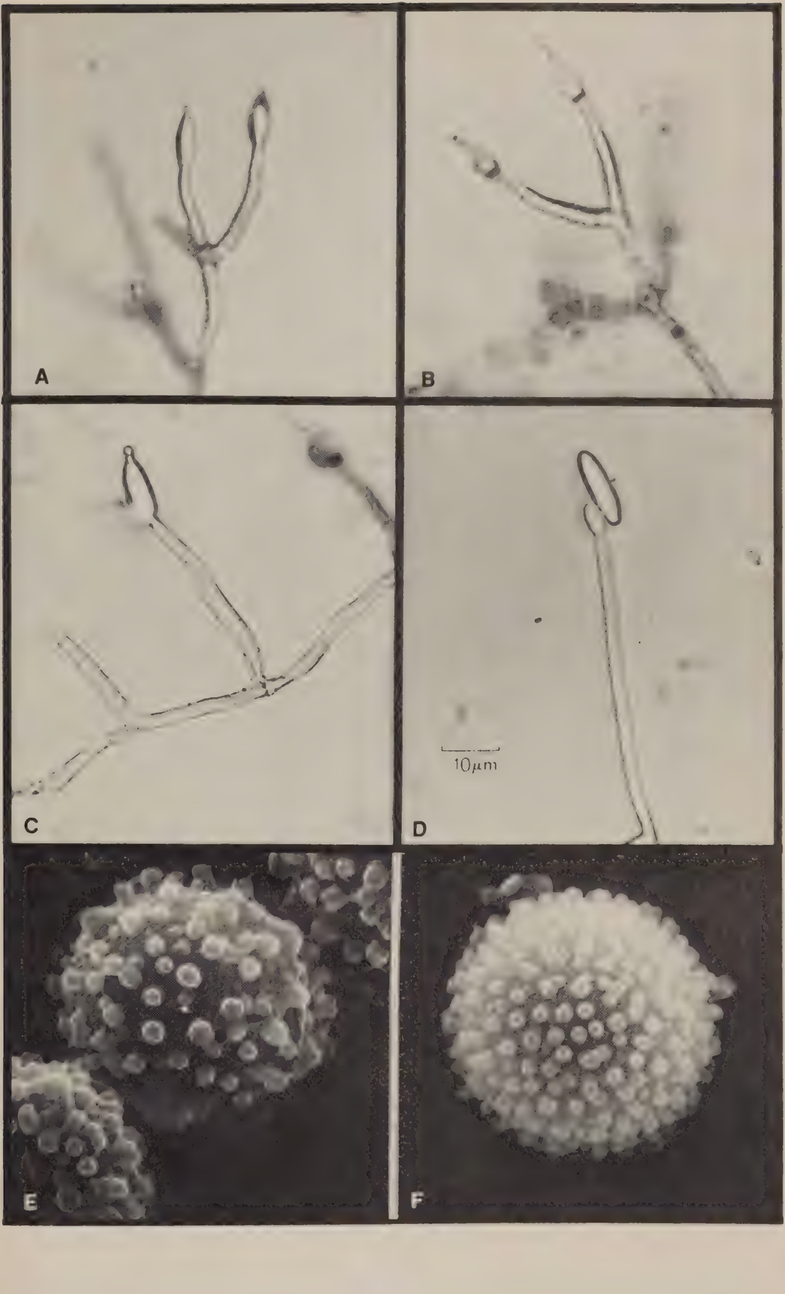
S. ampullosporum was originally described from collections made on *Boletus bicolor* Peck and *Strobilomyces floccopus* (Vahl. ex Fr.)Karst. in Rhode Island and North Carolina, together with material from São Paulo, Brazil [the fungus had been described earlier by Viégas (1945) from Brazil under the name *Sepedonium chrysospermum* Link ex Fr. (*S. mycophilum*)] and a culture obtained from the Centraalbureau voor Schimmelcultures, Baarn, which Damon (1952) cites as type for the name. It has been reported from Japan by Tubaki (1955) and Matsushima (1975). Although it appears to be common in North Carolina it has not been collected in Alabama, where *S. mycophilum* occurs frequently on *Boletus* spp.

Sibirina lutea sp. nov. (Fig. 2).

Coloniae effusae, floccosae, albidae vel luteae. Mycelium effusum, partim superficiale, partim in substrato immersum, ex hyphis ramosis, septatis, hyalinis, levibus, 3 - 6µm crassis compositum. Conidiophora semimacronemata, mononemata, erecta, recta vel flexuosa, simplicia, septata, hyalina, laevia, usque ad 450µm longa, 3 - 5µm crassa. Cellae conidiogenae monophialidicae, determinatae, discretae, subulatae, hyalinae, 3-11 in verticillio disposae, 30 - 37 X 3 - 5µm. Conidia obovata vel fusiformia, uniseptata, leviter curvata, laevia, hyalina, 17 - 20 X 5.5 - 6µm.

Ad carposomata (?) Clavariae, Schenk Forest, Raleigh, Wake County, North Carolina, October 12, 1979, D.J. Gray, AUA, holotypus.

PLATE 1. A-C. *Sepedonium ampullosporum*, papillate conidia; D. *S. ampullosporum*, ellipsoid conidia; E. *S. ampullosporum*, chlamydospore (SEM X4,500);F. *S. mycophilum*, chlamydospore (SEM X5,000).


A
B
C
D
10μm
E
F

Colonies on PDA at first whitish, thin, then becoming densely lanose to floccose, cream to yellowish, buff when old, growing in diameter at a rate of 12 to 16mm per 24h at 25°C, reverse yellowish brown. Colonies on host substrate effuse, dense, becoming matted, at first white, then becoming yellow. Mycelium mostly superficial, partly immersed in the substratum, composed of cylindrical, flexuous, branched, hyaline, septate, smooth-walled, 3 - 6μm wide hyphae. Conidiophores semimacronematous, mononematous, straight or flexuous, hyaline, smooth, septate, simple or branched, bearing verticils of up to 12 conidiogenous cells terminally and intercalarly, up to 450μm long, 3 - 5μm wide. Conidiogenous cells monophialidic, discrete, arranged verticillately, determinate, subulate, attenuating gradually towards the apex, 30 - 37 X 3 - 5μm, tapering to 1 - 1.5μm wide at the tip. Conidia produced at the tips of the phialides, obovate to broadly fusiform, hyaline, 1-septate, slightly curved, 17 - 20 X 5.5 - 6μm, obtuse at the apex, narrowly truncate to slightly papillate at the base.

On carpophores of a clavarioid basidiomycete; North America.

Collection examined: Schenk Forest, Raleigh, Wake County, North Carolina, October 12, 1979, D.J. Gray, AUA, type.

Sibirina lutea, although similar, differs from *S. fungicola* Arnold, the type species of *Sibirina*, in several respects. Its cultural characteristics, particularly pigmentation, are at variance. The dimensions of its conidiogenous cells and conidia, although overlapping those of *S. fungicola*, also distinguish the two, those of *S. lutea* being consistently somewhat broader. The species are also easily separated on the basis of conidium morphology, the broadly fusiform, slightly curved conidia of *S. lutea* being distinctive.

Although de Hoog (1978) has questioned the validity of maintaining *Sibirina* as a separate entity from *Cladobotryum* Nees ex Steudel and has added a species to the latter genus, *C. curvatum* de Hoog and Gams, which possesses the characteristics of *Sibirina*, a conservative attitude is being adopted here. We concede, however, that ultimately a reappraisal of generic concepts in this complex must be undertaken, particularly if the aspirations of Kendrick (1980) for condensation of genera are to be subscribed to.

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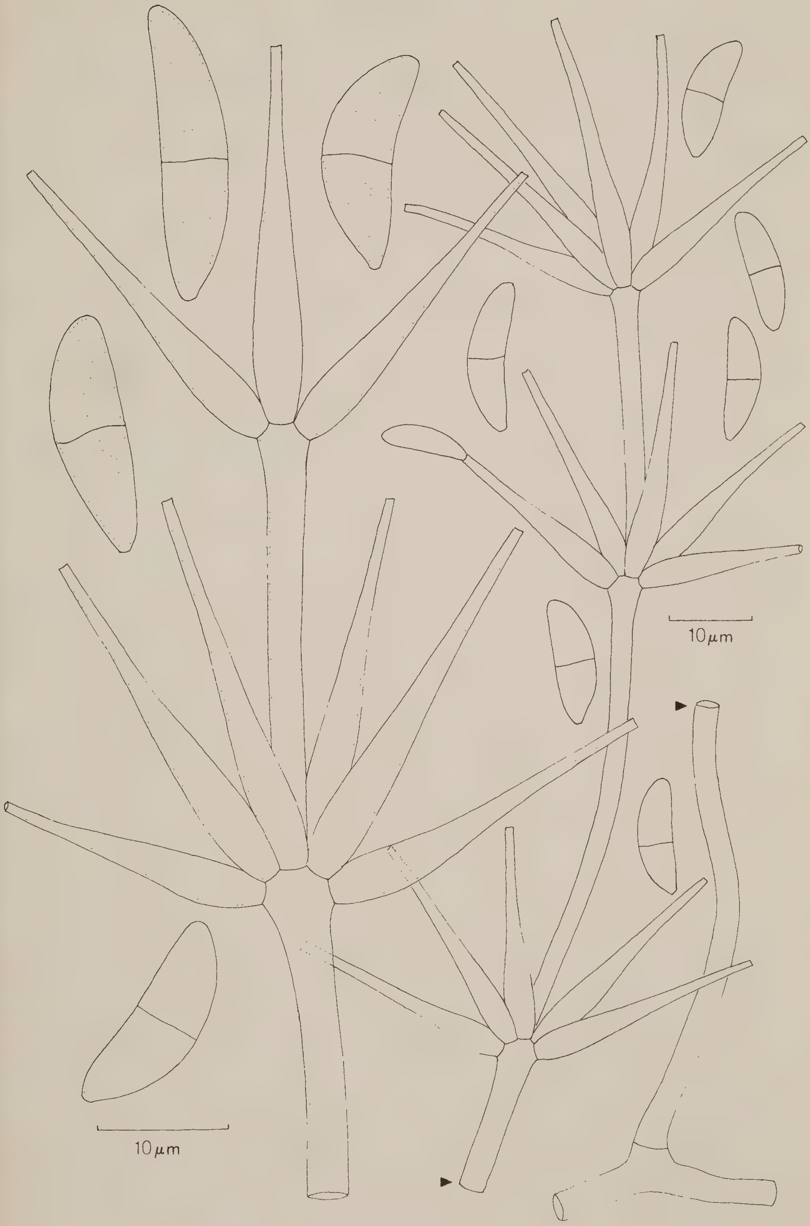

FIGURE 2. *Sibirina lutea*

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NOTES ON HYPHOMYCETES. XXXIX.
CYLINDROTRICHUM CURVATUM SP. NOV.

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ABSTRACT

Cylindrotrichum curvatum Morgan-Jones, a new species, is described and illustrated from a collection made on carpophores of *Stereum* sp. in Alabama.

INTRODUCTION

There has, in recent years, been a minor assault on the genus *Cylindrotrichum* Bonorden with the result that a total of eight species are presently accepted in it. Seven of these have been added during the course of the last five years.

Of Bonorden's original four species only one, *C. oligospermum* (Corda) Bon., which was chosen by Hughes (1958) as lectotype for the genus, is included. The remaining three names are excluded for varying reasons. *C. inflatum* Bon. is a synonym of *Menispora cylindrosperma* Corda while both *C. album* Bon. and *C. repens* Bon. are regarded as *nomina dubia* since absence of authentic material precludes their proper typification and they are therefore of uncertain application.

Species concepts in this genus, as in the closely similar *Chloridium* Link ex Fr. (the two genera are separated merely by the presence or absence of conidium septation), are based on relatively minor differences in conidiophore morphology and shape and size of conidia. This, of necessity, because of the simplicity of the organisms. In *Cylindrotrichum* degree of conidium septation is an added criterion.

Matsushima (1975) described *Cylindrotrichum proliferum* Matsushima and *C. triseptatum* Matsushima from the same locality in Kagoshima prefecture, Japan. The former was isolated from woodland soil and the latter was collected on dead bark of an unidentified broadleaf tree. Ellis (1976) established the name *C. triseptatum* Ellis for a fungus found on dead leaves of *Glyceria maxima* S. Wats. in England [Morgan-Jones (1977) subsequently established the name *C. ellisii* Morgan-Jones for it, *C. triseptatum* Ellis being illegitimate on account of its status as a homonym of *C. triseptatum* Matsushima]. Gams and Holubová-Jechová (1976) transferred *Acrotheca zignoëllae* Höhnel to *Cylindrotrichum* and added two new species, *C. hennebertii* W. Gams and Hol.-Jech., and *C. clavatum* W. Gams, to it. These three species occur on dead wood of various trees. Morgan-Jones (1977) described *C. oblongisporum* Morgan-Jones from a collection made on dead wood in Alabama.

Of the species described to date several are almost identical. *C. proliferum* and *C. zignoëllae*, in particular, appear to be extremely close, both possessing monophialidic conidiogenous cells and conidia of similar morphology and dimensions. They might well be conspecific. *C. hennebertii* differs in having polyphialidic conidiogenous cells while *C. clavatum* is distinguished by its clavate conidia.

Material of a *Cylindrotrichum* has been collected on old carpophores of *Stereum* sp. in Alabama. Although overlapping several other species in conidium dimensions the organism is readily distinguishable by the morphology of its conidia. It is described as a new species herein.

TAXONOMIC PART

Cylindrotrichum curvatum sp. nov. (Fig. 1).

Coloniae effusae, brunneae vel griseo-brunneae, pilosae. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, subhyalinis vel pallide brunneis, laevibus, 1.5-2.5µm crassis compositum. Setae steriles absunt. Conidiophora macronemata, mononemata, solitaria vel interdum fasciculata, erecta, simplicia, recta vel leniter flexuosa, septata, brunnea vel pallide brunnea, apicem versus pallidiora, laevia, ex basibus bulbosis, usque ad 140 m longa, 4-5µm crassa, basi interdum ad 12µm inflata, apicem versus 1.5-2µm crassa. Cellae conidiogenae monophialidicae vel polyphialidicae, in conidiophoris integratae, terminales, cylindricae, cum collis minutis. Conidia ellipsoidea vel allantoidea, hyalina, laevia, leniter curvata, plerumque guttulata, 1-septata, 10-14 X 2.5-4µm.

Ad carposomata Sterei, off Rt. 50, 5 miles south of Lafayette, Chambers County, Alabama, July 26, 1979, G. Morgan-Jones, AUA, holotypus.

Colonies effuse, brown to greyish brown, hairy. Mycelium mostly immersed in the substratum, composed of branched, septate, subhyaline to pale brown, smooth, 1.5-2.5µm wide hyphae. Sterile setae absent. Conidiophores macronematous, mononematous, solitary or sometimes in

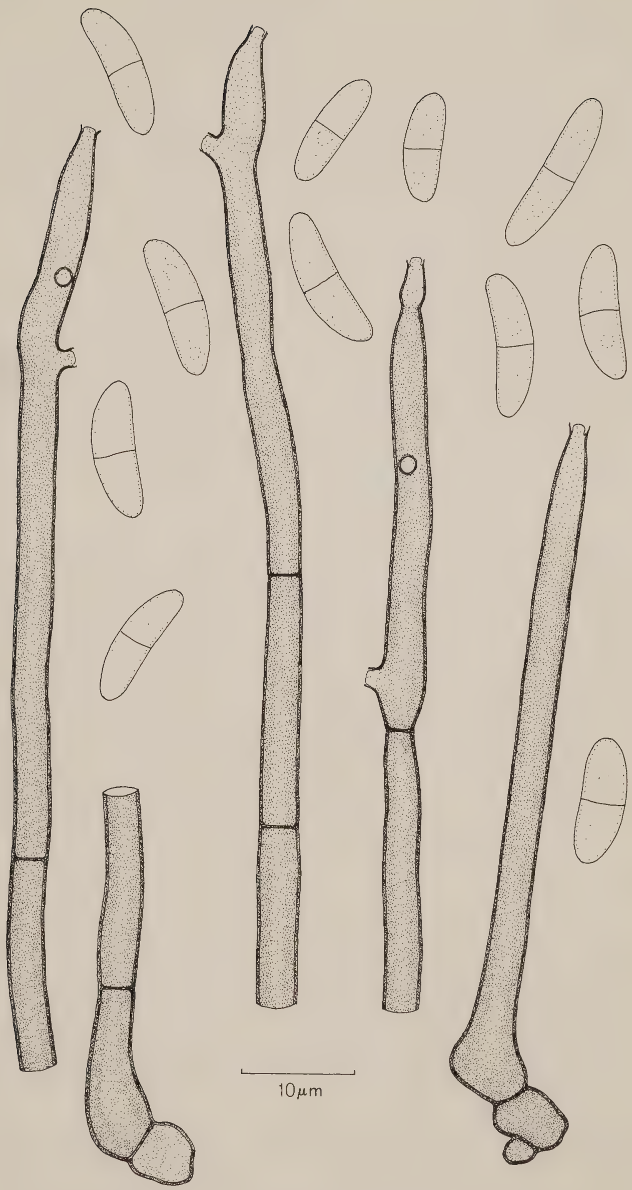

FIGURE 1. *Cylindrotrichum curvatum*

fascicles of a few, erect, simple, straight or slightly flexuous, septate, brown to pale brown, paler towards the apex, smooth, somewhat bulbous at the base, up to 140µm long, 4-5µm wide, swollen to 12µm at the base, apex 1.5-2µm wide. Conidiogenous cells monophialidic or, more frequently, polyphialidic, integrated, terminal, cylindrical, with up to 3 openings, each bearing a minute but easily discernible collarette. Conidia ellipsoid or allantoid, gently curved, hyaline, smooth, frequently guttulate, 1-septate, 10-14 X 2.5-4µm.

On carpophores of *Stereum* sp.; North America.

Collection examined: on *Stereum* sp., off Rt. 50, 5 miles south of Lafayette, Chambers County, Alabama, July 26, 1979, G. Morgan-Jones, AUA, holotype.

C. curvatum resembles *C. oligospermum* and *C. hennebertii* in possessing polyphialides. These are not, in terms of number of conidiogenous loci, as well developed as in the other two species however. *C. curvatum* is also easily differentiated from both species by its curved conidia.

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VALIDATION OF THE NAME OF THE YEAST SPOROBOLOMYCES HOLSATICUS WINDISCH

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Windisch (1949) described in German a new species which he named Sporobolomyces holsaticus. Although the species has been accepted by Lodder and Kreger-van Rij (1952) and by Phaff (1970), perusal of Windisch's publication revealed that he had neglected to provide a description in Latin. According to Article 36 of the International Code of Botanical Nomenclature, the name of a new taxon published on or after 1 January 1935 must have a description in Latin. In order to retain the taxon in a forthcoming review of the genus, the name is validated with the Latin description presented below.

The validly published name Sporobolomyces coralliformis Tubaki, which was listed as a synonym of S. holsaticus by Phaff (1970), would, if Phaff's classification were accepted, be the correct name of this taxon. However, the type of strain of S. coralliformis is sexually compatible with strains of Sporobolomyces salmonicolor (Fisher et Brebeck) Kluyver et van Niel and is no longer considered conspecific with S. holsaticus (Fell et Tallman, in prep.).

Sporobolomyces holsaticus Windisch ex Yarrow et Fell sp. nov.

In cultura in agaro maltoso post 7 dies ad 25°C

cellulae ovoidae vel longo-ovoidae 5-28 x 2-4 µm, singulae vel binnae. Mycelium septatum abundat. Color persicinus vel salmoneus. Ballistosporae asymmetricae.

Fermentatio: nulla.

Galactosum, sucrosum, maltosum, cellobiosum, trehalosum, D-xylosum, L-arabinosum, ribitolum, D-mannitolum assimilantur neque lactosum, L-rhamnosum, erythritolum, inositolum.

Kalii nitratum assimilatur.

Typus: CBS 1522 conservatur in Centraalbureau voor Schimmelcultures, Delft.

ACKNOWLEDGEMENT

Research by J.W. Fell is supported by the National Science Foundation, Systematic Biology Program.

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Windisch, S., 1949. _Sporobolomyces_ _holsaticus_ n. sp. Arch. Mikrobiol. _14_: 287.

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SCLEROTINIACEAE XVI.

ON HELOTIUM RUFO-CORNEUM AND HELOTIUM FRATERNUM

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SUMMARY

Two species previously referred to *Helotium*, *H. rufo-corneum* and *H. fraternum*, are redescribed and illustrated, and discussions on morphological and geographical variation are presented. Four species and a variety, *H. subserotinum*, *H. fuscopurpureum*, *Lanzia flavo-aurantia*, *H. miniatum* and *H. camerunense* var. *brasiliensis* are treated as synonyms of *H. rufo-corneum*; three additional species, *H. camerunense*, *H. aurantio-rubrum*, and *H. sloaneae* are treated as possible synonyms. *Helotium fraternum* is transferred to *Poculum* and *H. rufo-corneum* to *Lanzia*.

During the course of field work in the tropics and subtropics of Asia and throughout the neotropics, my colleagues and I have made several hundred collections of inoperculate discomycetes growing on leaf matter and woody substrata. Although much has been published by R. W. G. Dennis, R. P. Korf, W. C. Denison, and D. H. Pfister in recent years on the discomycete flora of the tropical regions, the inoperculate discomycetes are still poorly known.

Recently we have published (Carpenter & Dumont, 1978; Dumont & Carpenter, 1981; Carpenter, 1980) the findings on some of the more common species of the Leotiaceae found in the neotropics; an additional paper (Dumont, 1980) presents the results of a preliminary reinvestigation on the species of *Helotium* and *Hymenoscyphus* reported from the neotropics. However, it was not until the completion of these studies that I was able to identify and name satisfactorily a very common pantropical species originally thought by several workers to be a species of *Helotium* or *Hymenoscyphus*. In fact, at the onset of the work of identifying more than two hundred field collections, it was assumed that more than one taxon was involved, since the specimens being studied were from the new world and old world tropics and because they occurred on a wide variety of substrata.

The purpose of this paper is to redescribe and illustrate this common tropical species, to discuss the names encountered while trying to identify the fungus, and to comment on the importance of the extensive geographical and morphological-anatomical variations found. It is rare that so many collections of a single species are available for study, and it is for this reason that I have been able to place several species into synonymy and to understand, in part, some of the confusing anatomical variation. *Helotium fraternum* is also included in the present work since it was studied as a possible name for the species under consideration, and found also to be a member of the Sclerotiniaceae.

The methods employed in the present study are the same as those reported by Dumont, (1971).

1. *Helotium rufo-corneum* Berkeley & Broome, J. Linn. Soc., Bot. 14: 108. 1873. FIGS. 1-3.

≡ *Hymenoscyphus rufocorneus* (Berkeley & Broome) Dennis, Persoonia 3: 62. 1964.
= *Helotium subserotinum* P. Hennings & Nyman, Monsunia 1: 33. 1900.
≡ *Hymenoscyphus subserotinus* (P. Hennings) Dennis, Persoonia 3: 74. 1964.
= *Helotium fuscopurpureum* Rehm, Hedwigia 39: 94. 1900.
≡ *Hymenoscyphus fuscopurpureus* (Rehm) Dennis, Persoonia 3: 74. 1964.
= *Lanzia flavo-aurantia* P. Hennings, Hedwigia 41: 26. 1902.
≡ *Helotium flavo-aurantium* (P. Hennings) Rick, Brotéria, Sér. Bot. 25: 115. 1931.
= *Helotium miniatum* Patouillard in Duss, Enumération Champ. Guadeloupe & Martinique p. 65. 1903.
≡ *Hymenoscyphus miniatus* (Patouillard in Duss) Dennis, Persoonia 3: 74. 1964.
= *Helotium camerunense* P. Hennings var. *brasiliensis* Rick, Brotéria, Sér. Bot. 25: 114. 1931.
= ?*Helotium camerunense* P. Hennings, Bot. Jahrb. Syst. 22: 73. 1895.
≡ *Hymenoscyphus camerunensis* (P. Hennings) Dennis, Persoonia 3: 74. 1964.
= ?*Helotium aurantio-rubrum* Bresadola, Hedwigia 35: 295. 1896.
= ?*Helotium sloaneae* Patouillard, Bull. Soc. Mycol. France 16: 183. 1900.

Stroma — Substratal, variable, on the host leaf visible as blackened areas of the petiole and midveins and less commonly as irregular, black lines delimiting small, irregular areas of the leaf blade near the midvein; on the host wood difficult to observe or visible as diffuse black areas beneath the bark and as irregular, black lines in the wood or thin barks; the blackened areas in section composed of an incomplete rind of cells with differentially pigmented walls and epidermoid to irregular in face view; rind cells also present on the base of the stipe of the apothecium; not known in culture.

Macroconidial state — unknown, presumed absent.

Microconidial state — unknown.

Apothecial morphology — Apothecia variable, solitary with 1(-3) arising from each petiole in association with and from blackened areas of the substrate or on woody substrate arising scattered or in groups of 4-5, stipitate, 0.5-3(-5)mm in diam, and 0.5-2(-5)mm high, when fresh disc slightly concave, slightly convex or flat, drying cupulate to flat, and rehydrating flat to slightly cupulate. Hymenium when fresh generally yellow-orange to red-orange, occasionally with vinaceous tint, drying dark yellow-orange to reddish-orange, or less commonly dark vinaceous, rehydrating lighter; margin when fresh, dry, and rehydrated concolorous with the hymenium; receptacle when fresh, dry, and rehydrated generally lighter than the hymenium and light yellow-orange, dark flesh-colored, cream or less commonly concolorous with the hymenium; stipe when fresh, dry, and rehydrated in the upper portion, generally concolorous with the lower portion of the receptacle, becoming obviously blackened toward the base of the stipe, cylindrical or slightly broader above and tapering to the base, 0.25-3(-4)mm long and to ca 0.5mm wide; apothecia in 2% KOH emitting a light yellow, yellow-brown or rusty dye.

Apothecial anatomy — Asci 8-spored, (90-)120-180(-200)x(8-)10-16(-20) µm, produced from croziers, long cylindrical-clavate, gradually tapering toward the base and there becoming slightly expanded to form a small foot or truncate, wall 0.5-3(-5)µm thick enlarged at the subtruncate to papillate apex and there 2-4(-6)µm thick; pore J+, the walls staining generally faint blue, intense blue, more intense toward the base of the pore, or visible only as two basal or two apical dots in Melzer's reagent. Ascospores extremely variable, (20-)24-36(-60)x(2.5-)3-6(-8)µm, biseriate throughout, biseriate above and uniseriate below or obliquely uniseriate, hyaline, smooth, nonseptate, ends generally pointed, in outline generally inequilateral, frequently flattened on one surface, frequently slightly sigmoid and curved unequally and generally bent below midpoint of spore, anterior end generally broader than posterior, posterior end frequently becoming drawn out to a fine point, anterior end (and less commonly posterior end) frequently becoming "flared" and variously modified; guttules filling the spore, anterior ones generally larger than posterior ones, spherical, elongate or irregularly shaped, individually separated by a narrow band of cytoplasm (occasionally giving the false impression of a septate spore). Paraphyses generally exceeding the asci and frequently completely surrounding the apices of the asci, internally hyaline or rarely light yellow-brown, branching at the base of the asci and toward the middle, septate, filiform, becoming slightly expanded at the apex and there (1-)2-3(-5)µm wide, walls thin, smooth and hyaline. Subhymenium not well differentiated from the medullary excipulum, hyaline to faint light brown, consisting of hyphae narrower and more tightly interwoven than the medullary excipulum, the individual hyphae hyaline, 1-4µm wide, the walls thin to ca 1µm thick, hyaline and smooth. Medullary excipulum well developed, obconical, non-refractive, hyaline, consisting of septate, branched, loosely interwoven to subparallel hyphae 2-5(-8)µm wide, the walls thin, non-refractive, hyaline and smooth. Ectal excipulum: inner ectal excipulum well defined and generally well differentiated from the outer ectal excipulum and grading into the medullary excipulum, entire layer non-refractive to occasionally slightly refractive (due to thickened cell walls and lacking a gelatinous matrix), 8-15µm wide toward the margin and ca 15-30µm wide toward the stipe, consisting of tightly compact, parallel to slightly interwoven, hyaline or light brown hyphae 2-3(-5)µm wide, the walls thin, generally non-refractive, hyaline and smooth. Outer ectal excipulum generally non-refractive, non-gelatinized, occasionally refractive due to thick walls, entire layer hyaline, ca 15-30µm broad toward the margin and 10-40µm toward the stipe, consisting predominantly of textura prismatica with the individual hyphae extending parallel or at a low angle to the surface of the apothecium, the individual cells toward

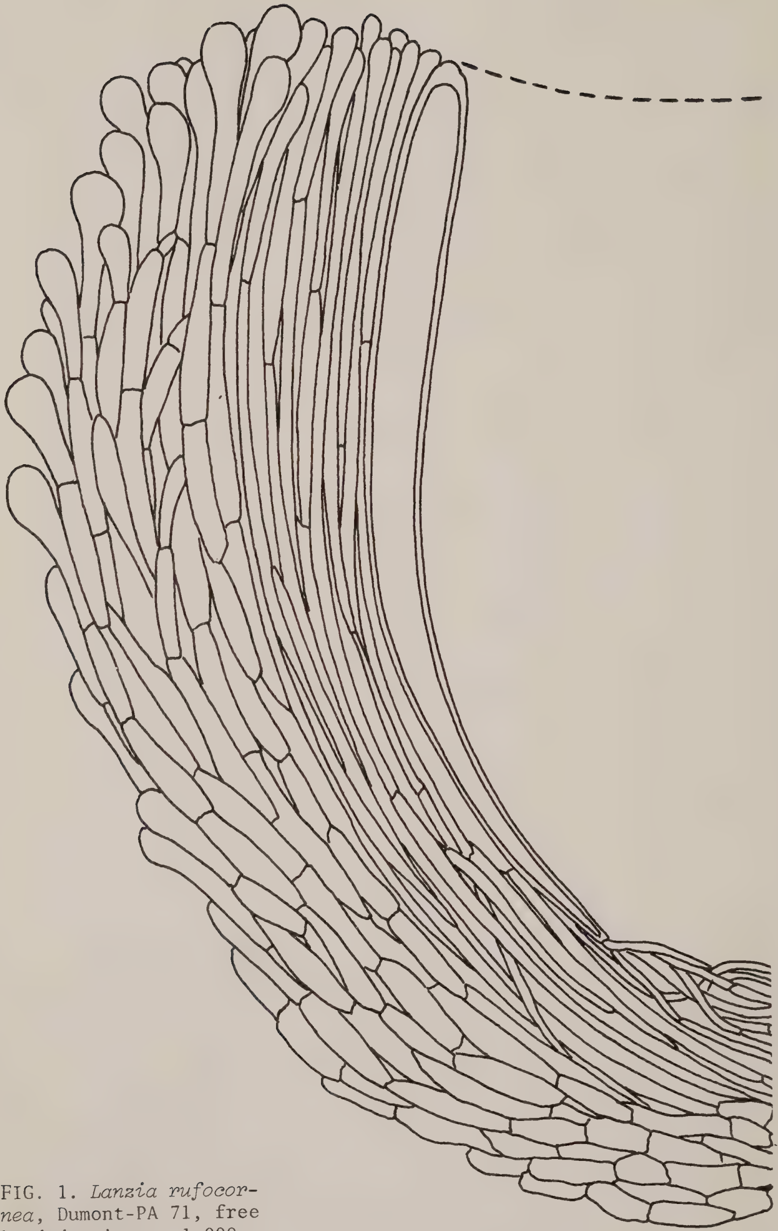


FIG. 1. *Lanzia rufocornea*, Dumont-PA 71, free hand drawing, x 1,000. Median longitudinal section of an apothecium through margin.

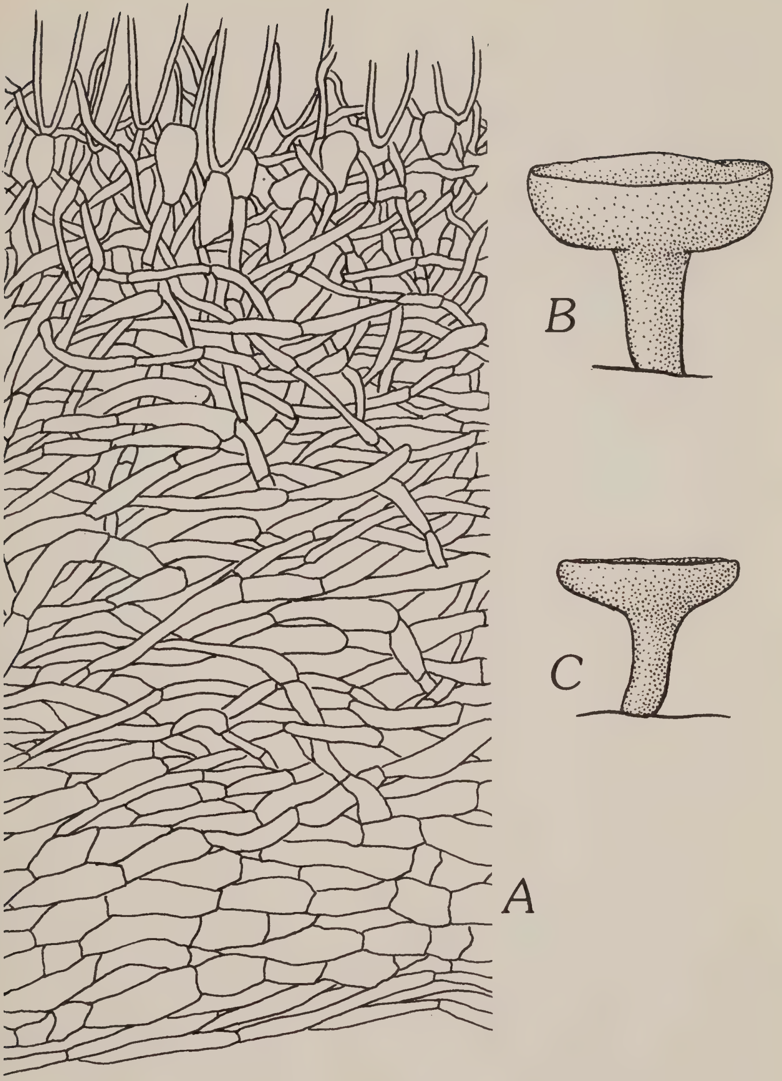


FIG. 2. *Lanzia rufocornea*, free hand drawings. A. Median longitudinal section through an apothecium at approximately midpoint between margin and stipe, Dumont-PA 71, x 1,000. B, C. Habit sketches of apothecia on the substrate; B, Dumont-PA 71, C, Dumont-PA 103, both x ca 50.

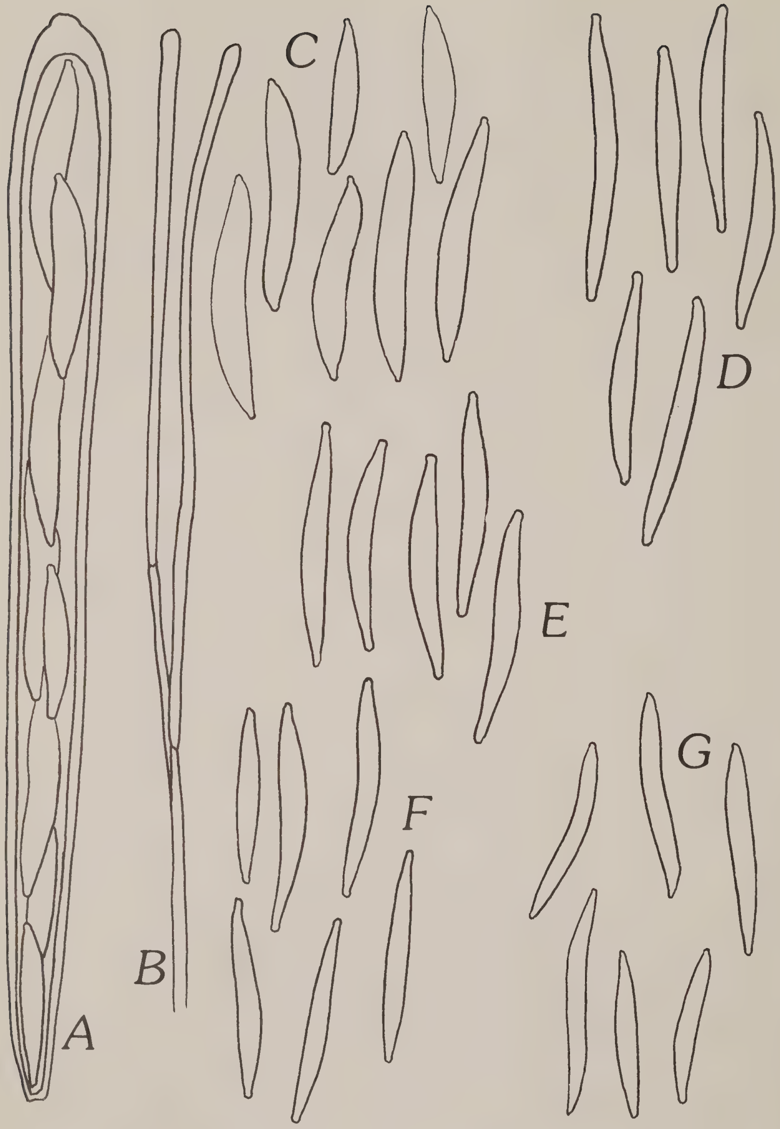


FIG. 3. *Lanzia rufocornea*, free hand drawings, x 1,000. A. An ascus with 8 ascospores, Dumont-PA 71. B. A branching paraphysis, Dumont-PA 71. C.-G. Ascospores; C, Dumont-PA 71, D, CUP-SA 2900, E, CUP-SA 3031, F, CUP-SA 3164, G, Dumont-PA 52.

the margin 8-21x4-8μm to 9-45x5-11μm toward the stipe, the walls thin and non-refractive to thick and refractive, hyaline and smooth; in poorly preserved material the individual cells collapsing and appearing narrow, and when walls thick, resulting in a highly refractive excipulum easily mistaken for a gelatinous matrix. Outer covering layer present, consisting of 1-3 hyphal layers and 2-6μm wide, the individual hyphae extending parallel to the surface of the apothecium, overlapping, and hyaline to light brown, the walls generally thin, hyaline and smooth or rarely roughened; toward the margin the apically free cells occasionally becoming expanded as in the margin. Margin well developed, occasionally broader at the tips of the asci than at the bases, entire zone hyaline or very light brown, constructed similarly to the apothecial flanks below, the individual cells smaller, the apical cells generally becoming slightly to obviously expanded and 4-10(-14)μm wide. Stipe in the upper portion constructed similarly to the lower portion of the apothecial flank; at approximately midpoint to the outside a zone of narrow, hyaline to light yellow-brown, 2-5μm wide hyphae with thin, smooth walls, to the inside a zone of parallel, hyaline to light brown hyphae with brick shaped cells with walls thin to thick, hyaline to brown, smooth to roughened and grading into longer and narrower cells in the central core; at the very base composed of narrow, tightly interwoven hyphae with rind cells to the outside. Hairs present or absent, more evident on the stipe and especially toward the base, hyaline to light brown, septate, 4-32μm long, 3-7μm wide at the apex, 3-7 μm at the basal septum, the walls thin or thick, hyaline to light brown, smooth or less commonly roughened.

Habitat: Commonly found on leaves and leaf parts and wood, branches, branchlets and twigs, less commonly encountered on herbaceous stems and roots. Leaf part: *Rhus succedanea*, *Distylium racemosum*, *Cecropia peltata*, *Eugenia borinquensis*, *?Eugenia jambos*, *Eugenia* sp., *Miconia pachyphylla*, *Sloanea* sp., *Clusia* sp., *Alchornea* sp., Malvaceae, Leguminosae. Woody part: *Stachyurus praecox*, *Fagus* sp., *Castanopsis cuspidata* var. *sieboldii*, *Distylium racemosum*, *Psychotria manillensis*, *Quercus induta*. Roots of *Aucuba japonica*, *Cryptomeria japonica*.

Etymology of the specific epithet: refers to the color and possibly shape and/or consistency of the apothecium.

Holotype: Sri Lanka (specific locality not given), on dead wood, (date not given), G. H. K. Thwaites 282 (K).

Types of designated synonyms: Neotype (designated here) of *Helotium subserotinum* Hennings & Nyman: Indonesia, Java, Tjibodas, along trail up Mt. Gedeh, 5 Jan 1967, K. P. Dumont & Nurta (CUP-SA 3031, isoneotype NY); Lectotype (designated here) of *Helotium fuscopurpureum*: Brazil, Serra dos Orgaos, Ad lignum vetustum, E. Ule 2500 (S); Holotype of *Lanzia flavo-aurantia*: Brazil, Sta. Catharina, near Blumenau, Holz, 26 Nov 1891, A. Möller 259 (S, ex herb Sydow - in the event that there are additional portions of this collection of which I am unaware, I designate this one as the lectotype.). Holotype of *Helotium miniatum*: Guadeloupe, Pointe Noire, sur l'ecorce pourrie d'un Caccaoyer, (date unknown), Duss 608 (FH). Presumed holotype of *Helotium camerunense* Hennings var. *brasiliensis* Rick: Brazil, São Leopoldo, on wood, (date not given), Rick (NY).

Illustrations: Dennis, Kew Bull. 1954: 328, fig. 37, 1954 (as *Helotium miniatum*). Dennis, Kew Bull. 1954: 329, fig. 38, 1954 (as *Helotium fuscopurpureum*). Dennis, Persoonia 3: 63, fig. 44, 1964 (as *Hymenoscyphus rufocorneus*). Penzig & Saccardo, Icones Fung. Javan. pl. XLV, fig. 3, 1904 (as *Helotium subserotinum*).

Specimens examined:

ASIA. JAPAN: Honshu, Kyoto Pref., between Kiyomizu Temple and Maruyama Park, Kyoto, on twigs, 23 Oct 1957, S. Imai, T. Hongo & R. P. Korf (CUP-JA 190); Kyushu, Miyazaki Pref., Shiratori Mt., near Iinomachi, Kirishima National Park, on twigs, 3 Nov 1957, S. Imai et al (CUP-JA 393); Honshu, Chiba Pref., Mt. Kiyosumi, on root of *Aucuba japonica*, 14 Apr 1958, S. Imai, Y. Kobayasi, D. Shimizu, K. Aoshima, K. Tubaki & R. P. Korf (CUP-JA 1010); Honshu, Chiba Pref., Mt. Kiyosumi, on twigs, 15 Apr 1958, S. Imai, Y. Kobayasi, D. Shimizu, K. Aoshima, K. Tubaki & R. P. Korf (CUP-JA 1023); Honshu, Asakawa Experimental Forest, Tokyo, on twig of *Stachyurus praecox*, 20 Apr 1958, K. Aoshima (CUP-JA 1053); Honshu, Tokyo, Mt. Takao, on root of *Cryptomeria japonica*, 4 Aug 1958, K. Tubaki 10030=40-2 (CUP-JA 1257); Yonezawa, Inego, on bark of *Fagus crenata*, 16 Aug 1958, K. Tubaki s.n., (CUP-JA 1266); Yonezawa, Inego, on bark of unknown tree, 16 Aug 1958, K. Tubaki 10061 (CUP-JA 1267); Yonezawa, Inego, on twig of *Fagus* sp., 17 Aug 1958, K. Tubaki 10054 (CUP-JA 1269); Honshu, Nara Pref., woods between Shinyakushi-ji and Kasuga-taisha, Nara, on branch, 24 Aug 1959, R. P. Korf (CUP-JA 1388); Honshu, Nara Pref., woods between Shinyakushi-ji and Kasuga-taisha, Nara, on exposed roots along a brook, 24 Aug 1959, R. P. Korf (CUP-JA 1389); Honshu, Nara Pref., woods between Shinyakushi-ji and Kasuga-taisha, Nara, on twig, 24 Aug 1959, R. P. Korf (CUP-JA 1407); Shikoku, Kochi Pref., along brook 1 km W of Ochi-machi, elev ca 75 m, on twigs of *Castanopsis cuspidata* var. *sieboldii*, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1412); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twig, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1416); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twig, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1419); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, elev ca 75 m, on twig, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1421); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twigs, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1433); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twigs, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1436); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twigs, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1438); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twigs, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1439); Shikoku, Kochi Pref., along creek N of Yokokura-jinja, Ochi-machi, elev ca 75 m, on twigs of *Castanopsis cuspidata* var. *sieboldii*, 25 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1442); Shikoku, Kochi Pref., along brooks between Sugimoto-jinja & Ontake-jinja, Yokokura-yama, elev ca 700 m, on twig, 26 Aug 1959, I. Ito, T. Wada, K. & R. P. Korf (CUP-JA 1482); Kyushu, Hida-gun, Oita-ken, Kita-mameda, Hida-machi, substrate not given, 27 Jul 1920, N. Nakayama (CUP-JA 1579); Kyushu, Miyoshi-mura, Hida-gun, Oita-ken, substrate not given, 10 Jul 1921, N. Nakayama (CUP-JA 1604); Honshu, Tokyo, Takaozan, substrate not given, 6 Sep 1936, R. Imazeki (CUP-JA 1614); Honshu, Tottori-shi, Tottori-ken, substrate not given, 8 Oct 1922, M. Tsuda (CUP-JA 1628); Ehime-ken, Shikoku, substrate not given, Aug 1916, Komatsuzaki (CUP-JA 1634); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1909); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1913); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1921); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1925); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1927); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1931); Yaku Island, valley S of RR bridge Yokotani, 3 km W of Ambo, Kagoshima-ken, on twig, 18 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1943); Yaku Island, woods 1-3 km NW of Kosugidani, Kagoshima, on twigs, 19 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 1989); Yaku Island, Suzukawa Valley, near Onoaida, Kagoshima-ken, on branchlet, 22 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2061); Yaku Island, Suzukawa Valley, near Onoaida, Kagoshima-ken, on wood of branchlet, 22 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2064); Yaku Island, Takinogawa Valley, ca 5 km N of Nagata, Kagoshima-ken, on twig, 23 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2096); Yaku Island, 2-4 km S of Nagata, along Nagata River Valley, Kagoshima-ken, on twigs, 25 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2106); Yaku Island, 2-4 km S of Nagata, along Nagata River Valley, Kagoshima-ken, on twigs, 25 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2107); Yaku Island, 2-4 km S of Nagata, along Nagata River Valley, Kagoshima-ken, on twigs, 25 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2108); Yaku Island, 2-4 km S of Nagata, along Nagata River Valley, Kagoshima-ken, on twigs, 25 Oct 1961, Y. Kobayasi, Indoh, K. Tubaki, Soneda, Furukawa & R. P. Korf (CUP-JA 2109); Yaku Island, near roadside between Yoshida and Shisenohana, Kagoshima-ken, on twigs, 26 Oct 1961, Y. Kobayasi & R. P. Korf (CUP-JA 2114); Yaku Island, in woods at side tributary, stream of Ambo River, ca 1 km W of Ambo, Kagoshima-ken, on twigs, 29 Oct 1961, Y. Kobayasi, Indoh & R. P. Korf (CUP-JA 2144); Honshu, Nanzenji Temple, Kyoto, on twig, 4 Nov 1963, M. Hamada, T. Hongo, K. Tubaki & R. P. Korf (CUP-JA 2828); Honshu, Shiga Pref., grounds of Mii Temple, Otsu, on twig, 5 Nov 1963, T. Hongo, K. Tubaki, T. Kusaka, Y. Shidei & R. P. Korf (CUP-JA 2837); Honshu, Shiga Pref., grounds of Mii Temple, Otsu, on twigs, 5 Nov 1963, M. Hamada, T. Hongo, K. Tubaki, K. T. & R. P. Korf (CUP-JA 2854); Okinawa, Yonaha-Daku, above Okuma, Kunigami-son, 400-475 m, on twigs of *Distylium racemosum*, 18 Mar 1966, R. P. Korf, K. P. Dumont, Z. Koja & K. Kuroshima (CUP-JA 3083); Okinawa, Izumi Botanical Gardens, Motola-cho, on twig of *Distylium racemosum*, 19 Mar 1966, R. P. Korf, K. P. Dumont, Z. Koja & K. Kuroshima (CUP-JA 3109); Okinawa, near top of Katsuudake, Yabu-son, on petiole of *Distylium racemosum*, 20 Mar 1966, R. P. Korf, K. P. Dumont & K. Kuroshima (CUP-JA 3164); Ryukyus, Ishigaki Island, Azanakasuji, Arakawa, rotted branchlet of *Psychotria manillensis*, 20 Mar 1969, R. P. Korf et al. (CUP-JA 3216); Ryukyus Islands, Iriomote Island, along trail near Dai-Ni Futamata, Urauchi River, base of petiole of *Rhus succedanea*, 6 Apr 1969, R. P. Korf, C. Ogimi, K. Kuroshima, T. Nakamine & M. Shimoji (CUP-JA 3323); Ryukyus Islands, Iriomote Island, along trail near Dai-Ni Futamata, Urauchi River, on petiole of *Distylium racemosum*, 6 Apr 1969, R. P. Korf, C. Ogimi, K. Kuroshima, T. Nakamine & S. Shimoji (CUP-JA 3339); Ryukyus Islands, Iriomote Island, along trail near Dai-Ni Futamata, Urauchi River, on petioles of *Distylium racemosum*, 7 Apr 1969, K. Kuroshima & T. Nakamine (CUP-JA 3347); Ryukyus Islands, Iriomote Island, along trail near Dai-Ni Futamata, Urauchi River, on rotted wood of *Castanopsis cuspidata* var. *sieboldii*, 7 Apr 1969, K. Kuroshima & T. Nakamine (CUP-JA 3348); Ryukyus Islands, Iriomote Island, upper end of Nakama River, near Ohara, ca 10 m, on petioles of *Distylium racemosum*, 9 Apr 1969, R. P. Korf, K. Kuroshima, T. Nakamine, C. Ogimi & M. Shimoji (CUP-JA 3359); Okinawa, Yona Demonstration Forest, Yona, ca 750 m, on twig of *Castanopsis cuspidata* var. *sieboldii*, 18 Apr 1969, R. P. Korf, C. Ogimi & S. Kuniyoshi (CUP-JA 3426). CHINA: Ta-mu, Fukien, on fallen twigs, 17 Aug 1933, S. C. Teng 2008 (CUP-CH 41). TAIWAN: Chi-sing San, on twig of unknown species, 7 Dec 1975, Liou Sham-che (CUP 54938, ex F. of Taiwan 143); Wo-Zea, on twig of unknown species, 25 Jul 1975, Liou Sham-che (CUP 54944, ex F. of Taiwan 400). PHILIPPINES: Luzon, along trail up Mt. Makiling from Pansol side, Pansol, on twig in leaf litter, 9 Apr 1966, K. P. Dumont & I. J. Dogma (CUP-SA 913); Luzon, Go-Go Hill, Mt. Bonahao from the Sariaya side, on downed branch, 14 Apr 1966, K. P. Dumont, P. Zamora & B. Hernaeiz (CUP-SA 954); Luzon, Go-Go Hill, Mt. Bonahao from the Sariaya side, on downed branch, 14 Apr 1966, K. P. Dumont, P. Zamora & B. Hernaeiz (CUP-SA 955); Luzon, along the Lag Nas River, Mt. Bonahao, below ca 1900 m, on twigs, 17 Apr 1966, K. P. Dumont, P. Zamora & B. Hernaeiz (CUP-SA 1032); Negros, in vicinity of Barrio Matikil, Sitio Nagaro, on twigs, 6 Jul 1966, K. P. Dumont & D. R. Reynolds (CUP-SA 1115); Negros, in vicinity of Barrio Matikil, Sitio Nagaro, on twigs, 6 Jul 1966, K. P. Dumont & D. R. Reynolds (CUP-SA 1135); Negros, in vicinity of Barrio Matikil, Sitio Nagaro, on twigs, 8 Jul 1966, K. P. Dumont & D. R. Reynolds (CUP-SA 1196); Negros, vicinity of Barrio Matikil, Sitio Nagaro, on twigs, 9 Jul 1966, K. P. Dumont & D. R. Reynolds (CUP-SA 1215); Luzon, below Mud Springs, along road from Forestry Campus up Mt. Makiling, Los Baños, on twig, 29 Jul 1966, K. P. Dumont (CUP-SA 1307); Luzon, in vicinity of Mud Springs, Mt. Makiling, Los Baños, on twig, 30 Jul 1966, K. P. Dumont (CUP-SA 1351); Luzon, along trail leading up Mt. Makiling from the Quarry, on compound petiole, 8 Aug 1966, K. P. Dumont & B. Hernaeiz (CUP-SA 1382); Luzon, along road leading from Forestry Campus to Mud Springs, Mt. Makiling, Los Baños, on wood, 3 Sep 1966, K. P. Dumont et al. (CUP-SA 1682); Palawan, Inagawan Subcolony Penal Institute, km 54 from Puerta Princesa, on leaves, 7 Oct 1966, K. P. Dumont & J. V. Pancho (CUP-SA 1877); Sulu, Tawi Tawi, in vicinity of Sulu National Agricultural School, Tarawakin, on twig, 14 Oct 1966, K. P. Dumont & J. V. Pancho (CUP-SA 1896); Sulu, Tawi Tawi, S of campus of Sulu National Agricultural School, Tarawakin, on twig, 16 Oct 1966, K. P. Dumont, J. V. Pancho & Nebab (CUP-SA 1961); Luzon, Quezon National Park, Antinaonan, Quezon, on twig, 12 Nov 1966, K. P. Dumont (CUP-SA 2319); Luzon, in vicinity of University of Philippines Land Grant, km 97, 14 km past Siniloan towards Infanta, on twig, 17 Nov 1966, K. P. Dumont (CUP-SA 2342); Luzon, in vicinity of University of Philippines Land Grant, km 97, 14 km past Siniloan towards Infanta, on twig, 17 Nov 1966, K. P. Dumont (CUP-SA 2347); Luzon, in vicinity of Bulusan Lake, Bulusan, Sorsogon, on twig, 22 Nov 1966, K. P. Dumont (CUP-SA 2376); Luzon, in vicinity of Mud Springs, Mt. Makiling, Los Baños, on twig, 10 Dec 1966, K. P. Dumont (CUP-SA 2457). MALAYSIA: Ginting Highlands, Pahang, on petiole, 26 Dec 1967, K. P. Dumont & B. Stone (CUP-SA 2748). INDONESIA, JAVA: Mountain Garden & Jungle, Tjibodas, on twig, 8 Dec 1961, M. A. Rifai, R. Nasution & R. P. Korf (CUP-SA 54); Mountain Garden & Jungle, Tjibodas, on twig, 8 Dec 1961, M. A. Nasution & R. P. Korf (CUP-SA 77); jungle trail between Tjibodas and Tjibeureum Waterfall, on twig, 9 Dec 1961, M. A. Rifai, R. Nasution, Nurta & R. P. Korf (CUP-SA 87); jungle trail between Tjibodas and Tjibeureum Waterfall, on twig, 9 Dec 1961, M. A. Rifai, R. Nastion, Nurta & R. P. Korf (CUP-SA 112); jungle near Tjibodas, on twig, 10 Dec 1961, M. A. Rifai, R. Nasution & R. P. Korf (CUP-SA 150); along Tjiwalen River, Tjibodas, on twig, 11 Dec 1961, M. A. Rifai & R. P. Korf (CUP-SA 169); jungle trail between Tjibodas and Tjibeureum Waterfall, on twig of *Quercus induta*, 16 Dec 1961, M. A. Rifai &

R. P. Korf (CUP-SA 282); near pond, Tjibodas, on twig, 25 Dec 1961, M. A. Rifai & R. P. Korf (CUP-SA 419); along Tjiwalen River, near beginning of trail to Tjibeureum, Tjibodas, on twigs, 28 Dec 1961, M. A. Rifai & R. P. Korf (CUP-SA 495); Nature Reserve, Tjibodas, on twig of *Castanopsis* sp., 3 Jan 1967, K. P. Dumont & Nurta (CUP-SA 2950); along trail up Mt. Gedeh, Tjibodas, on twig, 4 Jan 1967, K. P. Dumont & Wirawan (CUP-SA 3000); along trail up Mt. Gedeh, Tjibodas, on twig, 6 Jan 1967, K. P. Dumont & Wirawan (CUP-SA 3069); along trail above falls, Mt. Gedeh, Tjibodas, on mossy branch, 7 Jan 1967, K. P. Dumont & Wirawan (CUP-SA 3137). SRI LANKA: Gannrouwa, Peradeniya, Central Farms, on twigs and petiole, 11 Jan 1967, K. P. Dumont & Peter (CUP-SA 3155); Corbet's Gap, Rangala, Central Prov., on leaf, 13 Jan 1967, K. P. Dumont & Peter (CUP-SA 3222); Mt. Pedro, Nuwara Eliya, on twig, 15 Jan 1967, K. P. Dumont & Peter (CUP-SA 3292).

NORTH AMERICA. JAMAICA: along trail to Silver Hill Gap, near Woodcutter's Gap, vicinity of Newcastle, Portland Parish, on large herbaceous stem, 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 125); along trail between Woodcutter's Gap and ruins of Major Waillin's House, Portland Parish, on petioles, 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 143); along Lady's Mile Trail to just S of Woodcutter's Gap, vicinity of St. Andrew Parish & Portland Parish, on petioles of ?*Eugenia* sp., 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 157); along Lady's Mile Trail to just S of Woodcutter's Gap, vicinity of St. Andrew Parish & Portland Parish, on petioles of ?*Eugenia* sp., 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 161); vicinity of Dick's Pond, W of Hardwar Gap, near Holywell Recreational Area and Wag Water River, St. Andrew Parish, ca 2800-3000 ft, on leaves, 10 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 243); along Lady's Mile Trail to just S of Woodcutter's Gap, vicinity of St. Andrew Parish & Portland Parish, on petioles of ?*Eugenia* sp., 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 319); along Lady's Mile Trail to just S of Woodcutter's Gap, vicinity of St. Andrew Parish & Portland Parish, on petioles of ?*Eugenia* sp., 9 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 335); trail between Barrett's Gap and Corn Puss Gap, St. Thomas Parish, on petioles, 15 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 504); trail between Barrett's Gap and Corn Puss Gap, St. Thomas Parish, on petioles, 15 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 548); trail from Whitfield Hall to Portland Gap to Blue Mt., border of St. Thomas and Portland Parishes, on petiole, 17 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 583); trail between Freetown and Wag Water River, near Hardwar Gap, St. Andrew Parish, on petioles, 18 Jan 1971, R. P. Korf, J. R. Dixon, K. P. Dumont, R. W. Erb, D. H. Pfister, D. R. Reynolds, A. Y. Rossman & G. J. Samuels (CUP-MJ 612). PUERTO RICO: near Pico del Oeste, in elfin forest, El Yunque, 1000 m, on leaf bases of *Eugenia* sp., 4 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3803); trail to El Toro, near km 13.5 on Rte 191, El Yunque, ca 750 m, on midribs, veins and rarely petioles of *Cecropia peltatum*, 5 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3814); trail to El Toro, near km 13.5, Rte 191, El Yunque, ca 750 m, on leaves of *Eugenia borinquensis*, 5 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3816); trail to El Toro, near km 13.5, Rte 191, El Yunque, ca 750 m, on leaves of *Miconia pachyphylla*, 5 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3832); near Pico del Este, in cloud forest, El Yunque, 1000 m, 8 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3912); near Pico del Este, on petioles of *Eugenia* sp., 8 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, J. H. Haines, D. H. Pfister, A. Y. Rossman, A. Sanchez & L. E. Skog (CUP-PR 3913). DOMINICA: woods and roadside near the Bee House, Springfield Estate, 7 mi from Roseau, 1200 ft, on stem, 21 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 70); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on petiole of *Sloanea* sp., 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 90); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on petiole of ?*Eugenia jambos*, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 92); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on twig, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 95); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on petioles and midribs of *Clusia* or *Coccoloba*, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 97); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on unidentified petioles, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 98); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on twig, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 99); Dom-Can lumbering area, W of Pont Casse, St. Paul Parish, 700 ft, on twig, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 101); Dom-Can lumbering area, along Layou River, St. Joseph Parish, 600 ft, on twigs, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 127); Dom-Can lumbering area, along Layou River, St. Joseph Parish, 600 ft, on twigs, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 129); Dom-Can lumbering area, along Layou River, St. Joseph Parish, 600 ft, on petioles, 22 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 134); woods near Pont Casse, St. Paul Parish, ca 2000 ft, on petioles and midveins of *Miconia* sp., 26 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 173); woods near Pont Casse, St. Paul Parish, ca 2000 ft, on petioles of *Clusia* sp., 26 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 181); woods near Pont Casse, St. Paul Parish, ca 2000 ft, on petiole of *Miconia* sp., 26 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 182); woods near Pont Casse, St. Paul Parish, ca 2000 ft, on twig, 26 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 183); woods near Pont Casse, St. Paul Parish, ca 2000 ft, on twig, 26 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 206); woods and orchards near Bee House, Springfield Plantation, 4 mi from Roseau, ca 1200 ft, on petiole base, 27 Jun 1970, R. P. Korf, J. B.

Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 254); along road near Pont Casse, St. Paul Parish, on twig, 29 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 297); along road near Pont Casse, St. Paul Parish, on twig, 27 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 309); along road near Pont Casse, St. Paul Parish, on petiole and midrib of leaf, 29 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 310); along road near Pont Casse, St. Paul Parish, on petiole of large compound leaf, 29 Jun 1970, R. P. Korf, J. B. Benson, J. R. Dixon, D. H. Pfister, A. Y. Rossman & L. E. Skog (CUP-DO 311). GUADELOUPE: Parc Tropicale, Les Mamelles, on twigs, 19 Jul 1974, D. H. Pfister 571 (FH); Plateau Dimba, along S side of Ravine Roche, on petioles and bases of indet. leaves, 20 Jul 1973, D. H. Pfister 576 (FH); along road D-23, 37 km from Basse Terre, Guadeloupe National Forest, ca 500 m, on petiole of member of Melastomataceae, 5 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 878 (FH); Les Mamelles, Guadeloupe National Forest, on petioles of member of Leguminosae, 5 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 880 (FH); Grande Etang, above Bonanier, 400-416 m, on petiole, 6 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 981 (FH); Grande Etang, above Bonanier, 400-416 m, on very wet herbaceous stem, under vine covering exposed lake edge, 6 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 1010 (FH); approach to Victor Hughes Trail, Grand Matouba, on stump, 8 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 1120 (FH); Parc Tropicale, on fallen leaf petioles, 10 Jan 1974, D. H. Pfister, S. E. Carpenter & M. A. Sherwood 1218 (FH). PANAMA: Prov. Panama, summit of Cerro Jefe, ca 23 km N of Pan American Highway, on indet. leaf, 11 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-52 (NY); Prov. Panama, summit of Cerro Jefe, ca 23 km N of Pan American Highway, on twig, 11 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-71 (NY); Prov. Panama, summit of Cerro Jefe, ca 23 km N of Pan American Highway, on leaves, 11 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-95 (NY); Prov. Panama, summit of Cerro Jefe, ca 23 km N of Pan American Highway, on petiole, 11 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-103 (NY); Prov. Cocle, from base of Cerro Pilón to summit, 5 km NE of El Valle, ca 2200-3000 ft, on petiole, 14 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-252 (NY); Prov. Cocle, from base of Cerro Pilón to summit, 5 km NE of El Valle, ca 2200-3000 ft, on petiole, 14 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-267 (NY); Prov. Cocle, from base of Cerro Pilón to summit, 5 km NE of El Valle, ca 2200-3000 ft, on petiole, 14 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-276 (NY); Prov. Cocle, vicinity of La Mesa, 2.5 km N of El Valle, ca 2100 ft, 14 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-321 (NY); Prov. Veraguas, along road from Sta. Fe to Calovebora, Atlantic slope, vicinity Rio Caloveborita, ca 16 km from Sta. Fe, ca 1000-2500 ft, on indet. leaf, 18 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-604 (NY); Prov. Panama, 10-12 km N of Pan American Highway, on the El Llano-Cartí Rd, on leaf, 28 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-1215 (NY); Prov. Panama, 10-12 km N of Pan American Highway, on the El Llano-Cartí Rd, on branch, 28 Jun 1975, K. P. Dumont, S. E. & S. M. Carpenter & S. Mori PA-1264 (NY); Prov. Panama, vicinity Alto de Pacora, 26-31 km N of Pan American Highway, on old road to Mandinga, ca 2100-2200 ft, on petiole, 30 Jun 1975, K. P. Dumont, S. E. Carpenter & S. Mori PA-1546 (NY); Prov. Panama, vicinity Alto de Pacora, 26-31 km N of Pan American Highway, on old road to Mandinga, ca 2100-2200 ft, on petiole, 30 Jun 1975, K. P. Dumont, S. E. Carpenter & S. Mori PA-1554 (NY); Prov. Panama, vicinity of Alto de Pacora, 26-31 km N of Pan

American Highway, on old road to Mandinga, ca 2100-2200 ft, on petiole, 30 Jun 1975, K. P. Dumont, S. E. Carpenter & S. Mori PA-1574 (NY); Prov. Panama, vicinity Alto de Pacora, 26-31 km N of Pan American Highway, on old road to Mandinga, 2100-2200 ft, on petiole, 30 Jun 1975, K. P. Dumont, S. E. Carpenter & S. Mori PA-1600 (NY). MEXICO: Serro de La Martinica, S de Banderilla, Vera Cruz, 1500 m, on twigs, 25 Sep 1975, G. Guzmán 12460 (ex ENCB, NY).

SOUTH AMERICA. COLOMBIA: Dpto. Antioquia, Buenos Aires, Providencia, Anorí, Rio Anorí, on plant debris, 5 Jul 1974, K. P. Dumont, J. H. Haines, L. F. Velásquez & R. Fonnegra CO-543 (COL, NY); Dpto. Antioquia, Buenos Aires, Providencia, Anorí, Rio Anorí, on leaf blade, 5 Jul 1974, K. P. Dumont, J. H. Haines, L. F. Velásquez & R. Fonnegra CO-570 (COL, NY); Dpto. Valle, vicinity Pance, above Rio Pance, on leaf of *Alchornea* sp., 12 Jul 1974, K. P. Dumont, J. H. Haines, J. M. Idrobo & L. F. Velásquez CO-1053 (COL, NY); Dpto. Cauca, Finca A. Castro, ca 5 km W of Popayan, road between Popayan and El Tambo, on leaf, 14 Jul 1974, K. P. Dumont, J. H. Haines, J. M. Idrobo & L. F. Velásquez CO-1301 (COL, NY); ca 13 mi from Florencia, on the Florencia-Doncello Rd, Intendencia Caquetá, ca 1200 ft, on leaf, 17 Jan 1976, K. P. Dumont, P. Buriticá, J. L. Luteyn & L. A. Molina CO-2896 (COL, NY); ca 13 mi from Florencia, on the Florencia-Doncello Rd, Intendencia Caquetá, ca 1200 ft, on leaf, 17 Jan 1976, K. P. Dumont, P. Buriticá, J. L. Luteyn & L. A. Molina CO-2933 (COL, NY); ca 43 mi from Florencia, on the Florencia-Doncello Rd, Intendencia Caquetá, ca 1400 ft, on leaf, 17 Jan 1976, K. P. Dumont, P. Buriticá, J. L. Luteyn & L. A. Molina CO-2939 (COL, NY); Dpto. Nariño, vicinity km post 90 from Pasto, on the Pasto-Mocoa Rd, on branch, 26 Jan 1976, K. P. Dumont, P. Buriticá, L. A. Molina & J. L. Luteyn CO-3686 (COL, NY); Dpto. Nariño, vicinity km posts 129-130 from Pasto, on the Pasto-Tumaco Rd, ca 4200 ft, on leaves, 20 Jan 1976, K. P. Dumont, P. Buriticá, J. L. Luteyn & L. A. Molina CO-3943 (COL, NY); Dpto. Boyacá, vicinity km post 115, on the Chocontá-Aguaclara Rd, ca 4000 ft, on petiole of leaf, 10 Jun 1976, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina CO-4662 (COL, NY); Dpto. Boyacá, vicinity km post 115, on the Chocontá-Aguaclara Rd, ca 4000 ft, on petiole of leaf, 10 Jun 1976, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina CO-4703 (COL, NY); Dpto. Boyacá, ca 21 km from Aguazul, on the Aguazul-Sogamoso Rd, ca 2700 ft, on petiole of leaf, 14 Jun 1976, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina CO-5252 (COL, NY); Dpto. Boyacá, ca 21 km from Aguazul, on the Aguazul-Sogamoso Rd, ca 2700 ft, on leaf, 14 Jun 1976, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina CO-5254 (COL, NY); Dpto. Boyacá, ca 21 km from Aguazul, on the Aguazul-Sogamoso Rd, ca 2700 ft, on leaves, 14 Jun 1976, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina CO-5283 (COL, NY); Dpto. Chocó, ca 7 km from Quibdó, on the Quibdó-Istmina Rd, ca 200 ft, on leaf, K. P. Dumont, S. E. Carpenter & M. A. Sherwood CO-5632 (COL, NY); Dpto. Antioquia, ca 123 km from Medellín, on the Medellín-Pto. Valdivia Rd, ca 7400 ft, on leaves, 13 Aug 1976, K. P. Dumont, S. E. Carpenter & M. A. Sherwood CO-6411 (COL, NY). GUATEMALA: towards base woods on Guatemala Rte 17, between Tactic and Chilasco, near Union, on bark, 3 Aug 1973, A. L. Welden 3350 (NO, NY). VENEZUELA: Edo. Sucre, trail between Manacal and Los Pocitos, NW of Irapa, on unidentified root, 10 Jul 1972, K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morillo & J. Farfan VE-4573 (NY); Edo. Sucre, trail between Manacal and Los Pocitos, NW of Irapa, on leaf, 10 Jul 1972, K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morillo & J. Farfan VE-4599 (NY); Edo. Sucre, trail between Los Pocitos and Cerro Humo, NW of Irapa, on petiole, 12 Jul 1972, K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morillo & J. Farfan VE-4799 (NY); Edo. Sucre, trail from Los Pocitos through La Roma to town of Rio Grande Arriba, on leaf, 13 Jul 1972, K. P.

Dumont, G. J. Samuels, G. Morillo & J. Farfan VE-5026 (NY); Edo. Bolivar, trail up N facing slope of Uei-Tepui, from old military camp "Ciento Vienticinco", ca 118 km S of El Dorado, on road between El Dorado and Sta. Elena, on leaf, 5 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7016 (NY); Edo. Bolivar, trail up N facing slope of Uei-Tepui, from old military camp "Ciento Vienticinco", ca 118 km S of El Dorado, on road between El Dorado and Sta. Elena, on leaf, 5 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7039 (NY); Edo. Bolivar, km 116-117 S of El Dorado, on road between El Dorado and Sta. Elena, on leaf, 6 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7082 (NY); Edo. Bolivar, km 116-117 S of El Dorado, on road between El Dorado and Sta. Elena, on twig, 6 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7133 (NY); Edo. Bolivar, km 110-111 S of El Dorado, on road between El Dorado and Sta. Elena, on leaf, 6 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7159 (NY); Edo. Bolivar, km 110-111 S of El Dorado, on road between El Dorado and Sta. Elena, on wood, 6 Aug 1972, K. P. Dumont, R. F. Cain, G. J. Samuels & C. Blanco VE-7162 (NY). ECUADOR: Prov. Pichincha, ca 49 km SW of Chillogallo, on old road to Sto. Domingo, ca 7200 ft, on twig, 17 Jul 1975, K. P. Dumont, S. E. Carpenter & P. Buriticá EC 280 (NY).

NOTES. *Helotium rufo-corneum* is a widely distributed species, occurring throughout the subtropics and tropics of Asia and from Mexico through Brazil in the neotropics. In many regards it is the most variable species in the Sclerotiniaceae which I have thus far studied. Part of this variation may be due to its wide distribution and to its growth on a variety of substrata, such as woody hosts, leaf parts, and herbaceous stems. I have placed four species and one variety into synonymy with *H. rufo-corneum* and have suggested that an additional three may also represent this taxon. The proliferation in names is a result of previous workers describing new species from collections which in reality merely represented morphological variants, and it is only through having examined more than 200 collections in this study that I have been able to observe some of this extreme variation and to recognize these collections as extremes of a continuum. It is further possible that, because the species is so widespread and because it is brightly colored, more names remain to be found in the literature. It is not unlikely that a name older than *Helotium rufo-corneum* may be discovered.

Perhaps the most noteworthy variation in this species is the size of the ascospores, which measure from 20-60μm long amongst collections. Even in a single ascus variation is diverse, and I have seen ascospores in one collection (CUP-JA 1439), for example, in which apparently normal, healthy spores measured 25 x 4μm in the apical region of the ascus and 41 x 3.5μm in the basal portion. The width of the ascospores in this species is also variable and was found to be 2.5-8.0μm amongst collections. Within the groups of inoperculate discomycetes with which I am most familiar, the Sclerotiniaceae and certain groups in the Leotiaceae, a variation in length of 50-75% is common, 100% is rare, and the 300% found in *H. rufo-corneum* is exceptional. I have been unable to correlate the variation in ascospore size with any additional morphological or anatomical feature, and have only noted that in general the ascospores from collections on wood are more robust and broader than those from collections on leaves. However, I have seen many broad ascospores from foliicolous collections and narrow spores from lignicolous collections. It is also interesting to note that in collections from wood there seems to be a higher proportion of misshapen and seemingly aberrant spores than in collections from leaves. Another variable character observed in the ascospore is the "flaring" of the tips of the ascospore. In many collections the flaring is totally absent, while in others it is present in most of the spores. In some ascospores the flaring is obvious, while in others from the same collection or even within the same ascus, it is difficult to detect (Fig. 3).

In general, the external coloration of the apothecia in *H. rufo-corneum* is relatively consistent, but I have noted a few collections occurring on wood in which the apothecia have a purplish or vinaceous tint or cast. These apothecia also tend to be slightly larger than those of other collections. It is also in these collections that I have observed the broadest and most misshapen ascospores. It is possible that the frequent differences in the width of the ascospores between collections on wood and leaves and the differences in coloration are nutritional, as no other meaningful variation in the anatomy and morphology has been detected.

Although I have observed considerable variation in many features in this species and have studied several collections which could be distinguished from other collections, I have observed a gradation from these extremes to the more common situation to other variations. In view of the apparent lack of consistent variation and lack of correlation of variable features, I do not feel warranted in recognizing more than one species. Nor do I consider it wise to recognize infraspecific taxa for any of these variants, since I do see this gradation or continuum of variation from one extreme to the other.

Dumont and Carpenter (1981) also noted unusually large anatomical and morphological variation in their study of *Hymenoscyphus caudatus* and related species from the neotropics. They too had many recent field collections of each species from which to gather data. It is becoming evident that a wide range of anatomical and morphological variation in tropical species occurs perhaps more than in temperate species, and that the amount of variation in each species is dependent on the number of collections being studied.

In *H. rufo-corneum* there are several cohesive, although sometimes variable, characters present. The dry apothecia emit a yellowish brown to rusty brown dye in 2% KOH. The apically free cells in the margin are characteristically expanded, the apothecial coloration is generally orange to red-orange, and the general shape of the apothecium is relatively consistent. Although the flared ascospore tip is not present in all collections, it is present in the majority of them. I know this feature from no other species in the Leotiaceae or Sclerotiniaceae.

Helotium subserotinum Hennings & Nyman was described from a Nyman collection from Tjibodas, Java. I have been unable to locate type or authentic material of this species and designate herewith CUP-SA 3031 as the NEOTYPE specimen for this species. The specimen was chosen for the following reasons: it was collected in the type locality, it agrees with the original description, and the collection contains several apothecia. The portion of the specimen deposited at CUP is considered the NEOTYPE and the small fragment deposited in NY the isoneotype. Dennis (1964) transferred the species to *Hymenoscyphus*, a decision with which I do not agree. I have compared the neotype collection with the holotype collection of *Helotium rufo-corneum* and find them to be synonymous. *Helotium rufo-corneum* was described before *H. subserotinum*.

Helotium fuscopurpureum Rehm was described as occurring on wood in south Brazil by Rehm (1900). In the original description Rehm cited Ule 2500 as the single collection studied, and it is thus the holotype collection. He further indicated that a portion of the original collection was deposited in the Pazchke Herbarium, and Friederischsen (1973) indicated that a portion of Ule 2500 was also deposited at HB. I herewith designate the portion deposited at S as the lectotype specimen for *H. fuscopurpureum*, since it agrees with the original description, and is the specimen upon which Rehm based his description; it contains his handwritten notes used in preparing the original description. I have not attempted to examine the isolectotype portions deposited at either HB or the Pazchke Herbarium. Dennis (1964) transferred the species to *Hymenoscyphus*; however, I have compared the Ule 2500 with the holotype of *H. rufo-corneum* and conclude that they are synonymous. *H. rufo-corneum* has priority.

Lanzia flavo-aurantia was described from south Brazil by Hennings (1902) as occurring on wood, and the species was transferred to *Helotium* by Rick (1931). I have examined the holotype of this species, Möller 259 deposited at S, and have compared it with the holotype of *H. rufo-corneum* and conclude that they represent the same species. The latter name has priority.

Helotium miniatum was described on *Theobroma* from Guadeloupe by Duss (1903). Dennis (1954) suggested that this species could be synonymous with *H. aurantio-rubrum* Bresadola. He described and illustrated the type of *H. miniatum* (Duss 608), demonstrating the slightly flared ascospore tips, the expanded marginal apical cells, and discussed the yellow dye emitted in 2% KOH. Dennis (1964) transferred the species to *Hymenoscyphus*, a decision with which I do not concur. I have compared Duss 608 with the holotype of *H. rufo-corneum* and conclude that they represent the same species; the latter name has priority.

Helotium camerunense was described by Hennings (1895) from West Africa as occurring on twigs. Dennis (1958) reported the species from Bolivia and apparently based on his knowledge of these collections, not of the type, transferred the species to *Hymenoscyphus* (Dennis, 1964). I have been unable to locate the type specimen of *H. camerunense*, but based on the original description I feel that the species may be the same as *H.*

rufo-corneum. A final decision can be made only after the original type is located or a neotype designated. Dumont & Carpenter (1980) studied the collections upon which the Dennis report was made from Bolivia and found them to represent *Hymenoscyphus sclerogenus* (Berk. & Curtis) Dennis.

Helotium sloaneae was described by Patouillard (1900) from Guadeloupe as occurring on "pétioles pourissant de Sloanea Massoni," but Duss (1903) reported the species from Guadeloupe on "rameaux pourrissants d'un *Sloanea Massoni*." As Dennis (1954) mentioned, the type cannot now be located at FH or PC. The original description of *H. sloaneae* is suggestive of *Helotium rufo-corneum*. It is not uncommon to find collections of *H. rufo-corneum* with ascospores to 7 or 8μm wide, but very rare to find them from collections on petioles. The ascospore measurements for *H. sloaneae* in the original description were given as "30-37x7-8", which would fall within my concept of *H. rufo-corneum*. A final decision on the taxonomic position of this species can be made only after the holotype is located or a neotype is designated. I choose not to select a neotype from the material of Pfister (cited above) from Guadeloupe, because the ascospores in these collections are narrower than those reported in the original description.

Rick (1931) described *Helotium camerunense* Henn. var. *brasiliensis* Rick. In the original description he gave no data for the specimen upon which the description was based, and I have been unable to locate a specimen from the Rick herbarium at PACA which might be this collection. Nor have I been able to locate this specimen at any other herbarium, but there is a collection at NY from the Bresadola herbarium which could be this type. The specimen was collected in São Leopoldo, Brazil on wood by Rick, and the handwriting appears to be that of Rick. Rick did send many collections to Bresadola for identification, and it is possible that he did not keep a portion in his own herbarium. This specimen represents the presumed holotype, and bears the number "27=17!" I have examined this specimen, and I conclude that it represents another collection of *H. rufo-corneum*. I thus place this variety into taxonomic synonymy with *H. rufo-corneum*.

Although Dennis and other workers have placed *Helotium rufo-corneum* in the Leotiaceae, I have found that the species produces a stroma and is thus referred to the Sclerotiniaceae. The species is a member of the genus *Lanzia* which is characterized by 1) the production of a substratal stroma; 2) the presence of an ectal excipulum composed of a textura prismatica; 3) lack of a gelatinous matrix in the ectal excipulum; and 4) hyaline ascospores. I thus propose the formal transfer here as follows:

Lanzia rufocornea (Berkeley & Broome) Dumont, comb. nov.

≡ *Helotium rufo-corneum* Berkeley & Broome, J. Linn. Soc., Bot. 14: 108. 1873.

Due to the lack of information on the microanatomy of many species in *Lanzia*, I am uncertain as to which species *Lanzia rufocornea* is most closely related. Because of the generally large size of the ascospores, there are a few other species in the Sclerotiniaceae with which *L. rufocornea* could be confused. In *Ciboria peckiana* the apothecia are characteristically brown, do not emit dye in KOH and the ectal excipulum is composed of small celled textura prismatica giving rise to globose cells. In *Poculum mahoniae* there are two types of paraphyses present, the ascospores frequently contain oily resinous contents, and the ectal excipulum is composed of hyphae in a gel. In *P. juglandis* the ectal excipulum is also composed of hyphae in a gel. Collections on leaves could be confused with primarily two species. *Helotium fastidiosum* has many features in common with *L. rufocornea*, but in the majority of the ascospores the apices are hooked as in *Hymenoscyphus serotinus*. *Helotium fastidiosum* lacks the stroma of *Lanzia rufocornea* and is a good *Hymenoscyphus*. In *Helotium fraternum* the ascospores are (17-)19-21(-23)x3-5μm, have internal red-brown oily contents, and the ectal excipulum is composed of hyphae in a gel. It also is Sclerotiniaceous, and a complete description, illustrations, and discussion are provided here.

2. *Helotium fraternum* Peck, Annual Rep. New York State Mus. 32: 47. 1880 ('1879'). FIGS. 4, 5.

≡ *Hymenoscyphus fraternus* (Peck) Dennis, Persoonia 3: 76. 1964.

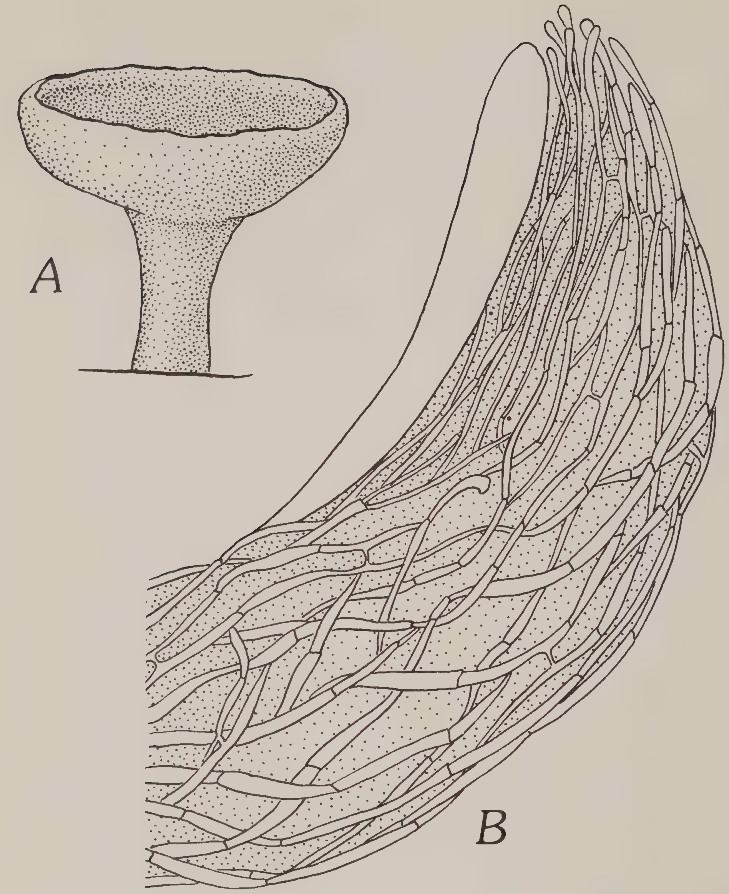
Stroma — Substratal, variable, visible on the host as irregular black patches or poorly developed black lines on petioles; the blackened areas composed of epidermoid to irregular cells in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

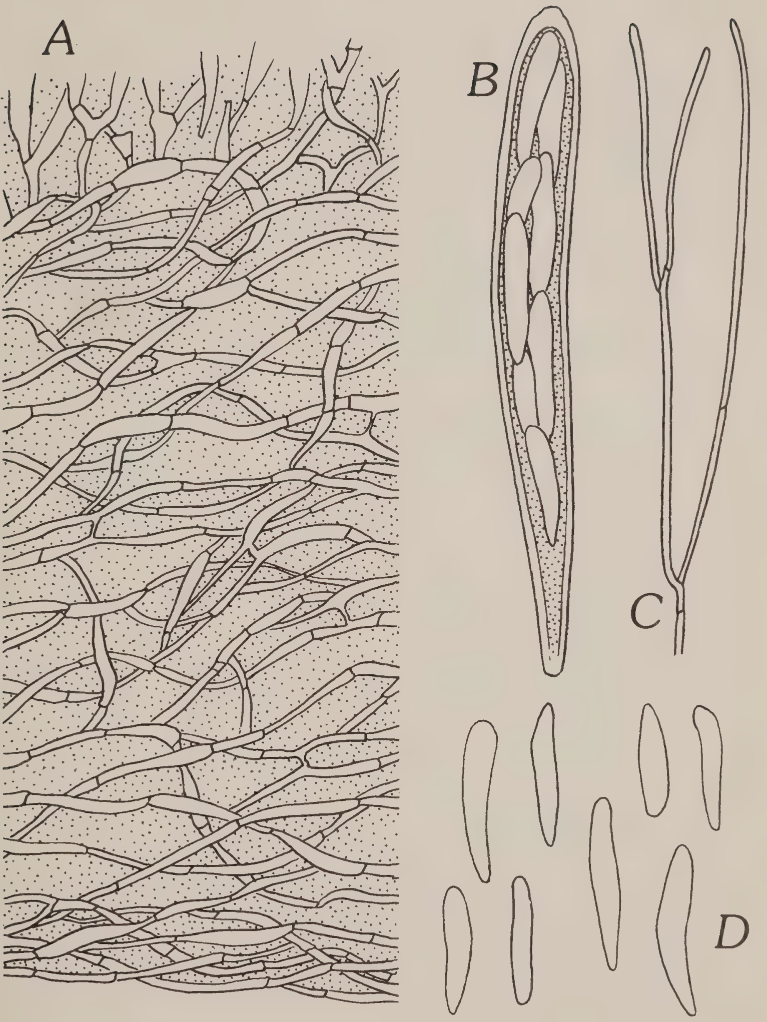
Apothecial morphology — Apothecia variable, solitary to gregarious, arising in association or from blackened areas of the host petiole, stipitate, 1-2mm in diam, 1-2(-3)mm high, when fresh disc at first subglobose, flat with maturity, drying slightly concave, rehydrating flat to slightly convex. Hymenium when fresh waxy yellow to ochraceous orange, drying dark reddish brown to nearly black, rehydrating lighter and giving off a slight rusty dye with tint of red in 2% KOH; margin when fresh, dry, and rehydrated concolorous with the receptacle; receptacle when fresh pale yellow to off-white, drying darker and grayish to flesh color, rehydrating lighter, but darker than hymenium; stipe above concolorous with the lower portion of the receptacle when fresh, dry, and rehydrated, becoming darker below and frequently black at the base.

Apothecial anatomy — Asci 8-spored (70-)80-100x(9-)10-12(-13)μm, produced from small croziers, long cylindric-clavate, gradually tapering to the base and there truncate, rounded or rarely forming a small foot, wall to ca 1μm wide, enlarged at the subpapillate to papillate apex and there 2-4μm thick; pore J+, visible as two dark blue lines or two apical dots in Melzer's reagent. Ascospores (16-)19-23(-24)x(3-)4-5μm, uniseriate to biseriate, generally pigmented light orange-yellow to red-orange by oily resinous contents, smooth, aseptate, ellipsoid, ends generally rounded, in outline inequilateral or less commonly equilateral, generally flattened somewhat on one surface, anterior end generally broader than posterior, frequently curved (occasionally above the middle of the ascospore), occasionally producing a slight beak, internal contents of spores difficult to



↑FIG. 4. *Poculum fraternum*, holotype ex NYS, free hand drawings. A. Habit sketch of an apothecium, x ca 50. B. Median longitudinal section of an apothecium through margin, x 1,000.

→FIG. 5. *Poculum fraternum*, holotype ex NYS, free hand drawings, x 1,000. A. Median longitudinal section through an apothecium at approximately midpoint between margin and stipe. B. An ascus with 8 ascospores. C. A branching paraphysis. D. 8 ascospores drawn after discharge from ascus.


A
B
C
D

observe owing to the oily, spumose material present, but probably with 2-several, spherical to irregular guttules. Paraphyses equal to or slightly exceeding the asci, with internal contents similar to ascospores, but darker, branching at the base of the ascus and toward the middle, filiform, slightly expanded at the apex and there 2-3μm wide, sparingly septate, walls thin or rarely slightly thickened, smooth, and hyaline (pigmentation is in the cytoplasm). Subhymenium not a well differentiated layer, grading into the medullary excipulum below. Medullary excipulum composed of hyphae similar to those of the ectal excipulum, in the center of the receptacle the hyphae interwoven and becoming more parallel in the flanks. Ectal excipulum: not differentiated into definite regions, relatively consistent from the margin to the stipe, to outside 1-2 layers of narrow hyphae with cells frequently containing oily material as in the paraphyses, to the inside the hyphae slightly interwoven, imbedded in a copious gel, widely spaced, individually 3-4(-5)μm, the walls indistinguishable from the gelatinous matrix, but presumed to be hyaline and smooth. Margin constructed similarly to the receptacle, but with less space between the individual hyphae. Stipe constructed similarly to the receptacle, no hairs or apically free hyphae observed; at the base of the stipe a layer of rind cells frequently observed, the cells irregular to epidermoid in outline and with differentially pigmented walls as seen in cross section.

Habitat: On petioles of *Acer* spp.

Etymology of the specific epithet: suggesting a relationship to another species, which according to Peck (1880) was *Helotium fastidiosum.*

Holotype: U.S.A., New York, Adirondack Mountains, on fallen maple petioles, July (year not given), C. H. Peck (NYS).

Illustrations: White, Mycologia 34: 158, fig. 4; 166, fig. 14, 1942.

Additional specimens examined: U.S.A., New York, Mt. Elba, fallen maple petioles, July (year not given), C. H. Peck (NYS).

NOTES. Helotium fraternum was described by Peck (1880) from New York state as occurring on petioles of *Acer*. White (1942) accepted its placement in *Helotium*, while Dennis (1964) transferred it to *Hymenoscyphus*. Based on the presence of a stroma produced by this species, I conclude that the species belongs in the Sclerotiniaceae, rather than the Helotiaceae (Leotiaceae) as indicated by previous workers. In view of the fact that the ectal excipulum of the apothecium is composed of hyphae embedded in a gel, I have concluded that the species is best placed in *Poculum* Vel. I thus propose the formal transfer as follows:

Poculum fraternum (Peck) Dumont, comb. nov.

≡ *Helotium fraternum* Peck, Annual Rep. New York State Mus. 32: 47. 1879 (1880).

Poculum fraternum appears to be most closely related to two foliicolous species of *Poculum*, *P. mahoniae* and *P. juglandis*. In *P. fraternum* the ascospores, frequently the paraphyses, and the hyphae of the outer covering layer contain oily, resinous, orange to brown-orange, red-orange matter, but in *P. juglandis* this substance is lacking. Oily resinous matter is present in both *P. mahoniae* and *P. fraternum*, and the two are most easily separated on their respective sterile tissues. In *P. mahoniae* the individual hyphae are composed of small brick-shaped cells which are tightly compact and with little gel, whereas in *P. fraternum* the individual hyphae are long and narrow and embedded in a copious gel, as in *P. juglandis*.

Acknowledgements

The author wishes to thank the hundreds of collaborators throughout the world who have made the field work in this study possible. It is unfortunate that each cannot be named individually. To the directors of the institutions who have loaned specimens from their respective institutions, I express my appreciation. The funding for the recent field work has been provided by the National Science Foundation grant GB 28593ff. The drawings have been prepared by Bobbi Angell.

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MYCOTAXON

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ADDITIONS TO THE FUNGUS FLORA OF BERMUDA I: A NEW SPECIES OF LACHNELLULA ON PITTOSPORUM

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INTRODUCTION

Despite the attention paid to the discomycete flora of Bermuda by Whetzel, White, Seaver, and others (see Waterston, **1947**), as yet little is known about the Trichoscyphelloideae of the islands. A recent mycological exploration in which the author took part has yielded several discomycetes new to science, among them an apparently undescribed species of Lachnellula occurring on Pittosporum undulatum.

While some authors (Dharne, **1965**) restrict the circumscription of the genus to saprophytes on and parasites of conifers, I prefer to follow Nannfeldt (**1932**) and Dennis (**1962**) in stressing microanatomical affinities, noting in particular both the ectal excipulum, composed here of heavily gelatinized textura oblita, and the hyaline, coarsely granulate, extremely profuse hairs so characteristic of Lachnellula. With its orange-yellow hymenium, characteristic hairs and excipular structure, and frequent association with the cut edges of living wood, this species shows clear affinities in Lachnellula yet cannot be accommodated in any previously described species. Preliminary cultural studies have not disclosed a conidial anamorph.

TAXONOMIC PART

Lachnellula pittospori Kohn, sp. nov.

Apothecia gregaria vel fasciculata, sessilia, hymenio rehydrato vitelli-

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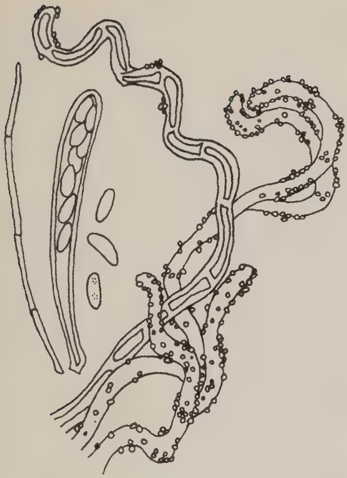
* Reprints through this address.



Lachnellula pittospori, paraphysis, ascus, 3 ascospores, hairs (one in optical section), drawn from the **holotype** with the aid of a drawing tube, reproduced at ×1000

no, receptaculi parietibus pilis albis dense vestitis; receptaculum ad 750 µm in diam., situ affixionis parum angustatum. Excipulum medullare ex textura intricata hyalina formatum, interdum in gelatina contentum, cellulis 1-2 µm latis. Excipulum ectale ex textura oblita hyalina intertexta formatum, in gelatina contentum, cellulis 3-5 µm latis, exterioribus extensis pilos formantibus. Pili ex cellulis excipularibus enati, hyalini, septati, interdum ramosi, grosse granulosi, ad 100 µm longi, 2-3 µm lati, secundum latera in tegetem densam intertexti, extremitatibus (pilorum) liberis, crispatis, as marginem saepe erecti. Asci clavati, ad basem angustati, ex uncis enati, 8-spori, 40-48 × 3-5 µm, apice parum incrassato, pori canalis pariete J— cum/sine usu KOH antecedente. Ascospori uni- vel biseriati, hyalini, fusiformi-ellipsoidei, juventute biguttulati, 5-8 × 1.5-2 µm. Paraphyses simplices, filiformes, septatae, ascos parum (3-5 µm) excedentes, 1 µm latae.

Apothecia gregarious to fasciculate, sessile, hymenium egg-yolk yellow upon rehydration, walls of receptacle densely clothed with white hairs; receptacle up to 750 µm in diam, tapering slightly at site of attachment. **Medullary excipulum** of hyaline textura intricata, sometimes bound in gel, cells 1-2 µm broad. **Ectal excipulum** of interwoven, hyaline textura oblita, bound in gel, with outermost cells turning out to form hairs, cells 3-5 µm broad. **Hairs** arising from excipular cells, hyaline, septate, occasionally branching, coarsely granulate, along flanks interwoven in a dense mat terminating as curled, free ends, at margin often erect, up to 100 µm long, 2-3 µm broad. **Asci** clavate, tapered at the base, arising from croziers, 8-spored, 40-48 × 3-5 µm, slightly thickened at the apex, pore channel wall J— both with and without KOH pretreatment. **Ascospores** uniseriate or biseriate, hyaline, fusiform-ellipsoid, biguttulate in youth, 5-8 × 1.5-2 µm. **Paraphyses** simple, filiform, septate, slightly exceeding the asci by 3-5 µm, 1 µm broad.

Habitat: on cut edges of stumps, pruned branches, etc. of *Pittosporum undulatum*.

Type Locality: Paget Parish, near Paget Marsh.

Holotype: R.P. Korf, leader, A.J. Caesar, S.E. Clark, S.C. Gruff, L.M. Kohn, G.R. Ramsey, D.L. Rist, A.Y. Rossman, J. Wymore, L.A. Wymore & J.E. Yuen, on cut end of girdled trunk of *Pittosporum undulatum*, Paget Parish, near Paget Marsh, Bermuda, U.K., 19.i.1980, CUP-BE **39**.

Paratypes: R.P. Korf et al., on ?*Pittosporum* or ?allspice, Paget Parish, Paget Marsh, Bermuda, 19.i.1980, CUP-BE **56**; R.P. Korf et al., on cut edge of stump of *Pittosporum undulatum*, Paget Parish, near Paget Marsh, Bermuda, 19.i.1980, CUP-BE **64**.

ACKNOWLEDGEMENTS

Both the expedition to Bermuda and the subsequent studies reported here were made possible through funds from the Anna E. Jenkins bequest to the Plant Pathology Herbarium, Cornell University. The hospitality and assistance of Dr. Idwal Hughes and Dr. David Wingate in Bermuda greatly facilitated the field studies on which this report is based. Dr. William J. Dress, Bailey Hortorium, kindly helped with the Latin diagnosis, and Robert Dirig, Bailey Hortorium, inked the drawings.

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TYPE STUDIES IN THE CLAVARIACEAE. VI.

FOUR PIVOTAL TYPES FROM THE PACIFIC TROPICS.

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Abstract

Type specimens of *Clavaria alcicornis*, *C. amoena*, *C. phoenicea* and *C. spiralis* are described and their proper taxonomic placement discussed.

Until the major compilation on clavarioid fungi by Corner (1950), the tropical taxa had been largely overlooked by the mycological community, which resided chiefly in the North Temperate zone. Recently, however, distribution patterns of such taxa have been shown to encompass temperate areas, making reconsideration necessary. Moreover, nomenclaturally, several names for such organisms predate those coined for fungi collected in temperate areas, making the names for some tropical taxa correct for their temperate analogs. The type specimens described here represent such taxa and names and so have become important to an understanding of the clavarioid fungi as a whole.

Clavaria alcicornis Zollinger & Moritzi. 1844. Natuur-Geneesk. Arch. Neerl.-Indië, p. 382.

Holotype: L - herb. Zollinger, "*Ad terram prope Tjikoya*", iii.184 . Plantae Javanicae no. 1125 [!]: merotype: FH [!].

Some years ago I (Petersen, 1967) reported that tramal hyphae and basidia were clamped on the FH portion of the type, but that no basidiospores were observed. On the original material at L, of which I had no knowledge in 1967, I can find no clamps on hyphae or basidia. The tramal hyphae are slightly inflated, thin-walled, simple-septate (occasionally apparently secondarily septate), short-celled and now adherent in sheets. The hymenium will not support observation, for the basidia are so gelatinized as to be shapeless, except for a rare apex protruding from the hymenial surface. One basidium was seen to be 4-sterigmate. A fruitbody is shown in Fig. 1.

Numerous basidiospores were present on the L material, however. They (Fig. 2) were 5.9-6.7 x 3.3-4.1 µm ($\underline{E}$ = 1.60-1.80; E^m = 1.69; $\underline{L}^m$ = 6.25 µm). Such spores, found in a taxon with clamps, would lead one to *Clavaria* subg. *Clavulinopsis* or to *Ramariopsis*, but the construction of the trama was unlike that found in either genus, especially the relatively short cells with occasional secondary septa. Both characters, together with the very thin-walled spores, lead directly to *Clavaria zollingeri*, a branched *Clavaria*. I am of the firm belief that the specimen represents a rosy form of that taxon.

Is there a rosy "*Clavulinopsis*" in tropical Asia? Fawcett (1939) described *C. pallidorosea*, but I have been unable to locate an adequate type, and her description does not permit accurate placement of the taxon. Van Overeem's (1923) treatment of *C. alcicornis* was not entirely true to the original description, and I have not examined his specimens under that name.

Clavaria amoena Zollinger & Moritzi. 1844. Natuur-Geneesk. Arch. Neerl.-Indië 1: 380.

Holotype: PC - herb. Léveillé, ex Plantae Javanicae cl. Zollinger lecta, no. 107.z, Tjikoya, ii.1843.

The specimen consists of two slender (up to 27 x 1.5 mm), simple fruitbodies (Fig. 3) joined at the base, arising from a very small mycelial pad. Fruitbodies now dull dark orange. Stipe portion (lower 2-4 mm) glassy, glabrous; club portion hardly thicker, smooth, dull.

Basidia up to 47 µm long, clavate, clamped; sterigmata four, rarely abnormally long and stout. Tramal hyphae clamped, parallel.

Spores (Fig. 4) 5.9-7.0 x 4.1-4.4 µm ($\underline{E}$ = 1.33-1.58; E^m = 1.47; $\underline{L}^m$ = 6.45 µm), ovoid to ellipsoid, usually flattened adaxially, smooth, thin-walled, hyaline (singly), usually uniguttulate; apiculus of moderate size, eccentric.

Corner (1950, 1970) assumed the identity of this name from the golden color attributed to the fruitbodies ("pulcherrime aurea" of Zollinger & Moritzi). Encountering a taxon with fasciculate, golden fruitbodies, he used this name, but attributed to it nearly spherical spores. Under this concept, the round-spored taxon was treated by Petersen (1968, 1971, 1980) with decreasing enthusiasm, but on other bases than examination of the type.

Interestingly, the type was annotated by Léveillé as *Clavaria helvola* Pers. That taxon exhibits warted-angular spores.

In my opinion, this specimen clearly represents a common Pacific tropical taxon which has passed under several names. A partial synonymy can be offered as follows:

Clavaria amoena Zollinger & Moritzi (ibid) [!]

≡ *Clavulinopsis amoena* (Zoll. & Mor.) Corner. 1950. Ann. Bot. Mem. 1: 352.

≡ *Clavulinopsis aurantio-cinnabarina* f. *amoena* (Zoll. & Mor.) Petersen. 1968. Mycologia Mem. 2: 25.

= *Clavaria aurantia* Cooke & Massee in Cooke. 1887. Grevillea 16: 33. [!]

= *Clavaria luteo-tenerrima* van Overeem. 1923. Bull. Jard. Bot. Buitenzorg III 5(4): 269. [!]

≡ *Clavulinopsis luteo-tenerrima* (v. Over.) Corner. 1950. Ann. Bot. Mem. 1: 377.

The nomenclatural fate of the taxon with gold colored fruitbodies and round spores has been taken up elsewhere (Petersen, 1980). The concept would now seem without a name, but if my conclusions are correct, this *anomie* may not be tragic.

In addition to exhibiting ellipsoid spores, the fruitbodies of the type arise from a mycelial pad, invariable for the types of all the above names.

Clavaria phoenicea Zollinger & Moritzi. 1844. Natuur-Geneesk. Arch. Neerl.-Indië 1: 381.

Holotype: PC - herb. Léveillé, ex Plantae Javanicae cl. Zollinger lecta, no. 1064, vic. Tjikoya, i-iii.1843.

Specimen a single fascicle of more than 14 individual, simple fruitbodies (Fig. 5) up to 25 x 3 mm, adherent at their bases but not arising from a mycelial pad; color now orange-brown; stipe and club portions now indistinguishable.

Basidia approximately 45 x 6 µm, clavate, clamped, golden-refringent under phase contrast; contents foamy; sterigmata not observed. Tramal hyphae of two types: a) up to 12 µm diam, clamped; wall up to 1 µm thick; b) up to 2.2 µm diam, clamped, thin-walled, copiously branched at almost 90° angles.

Spores (Fig. 6) 5.6-5.9 x 4.8-5.6 µm ($\underline{E}$ = 1.07-1.15; $\underline{E}^m$ = 1.10; $\underline{L}^m$ = 5.8 µm), spherical to subspherical, hyaline; wall thin; contents homegeneous; apiculus small, papillate.

This name represents a round-spored taxon with purple-red fruitbodies. Corner (1950, 1970) synonymized it with *Clavulinopsis miniata* (Berk.) Corner, and it is surely an older name for *Clavulinopsis miniata* var. *sanguinea* Corner (1950: 381, 694, pl. 7, fig. 3). Reid (1975) examined type material of *Clavaria miniata* in more detail than I, and found only ellipsoidal spores, not spherical as assumed by Corner (1950, 1970) and reported by me (Petersen, 1968) from the type. Both my notes and drawings indicate a paucity of probable basidiospores and a plethora of extraneous forms, and I gladly rely on the more complete data by Reid, especially for the specimen ex herb. Hooker. I agree with Reid that the round-spored organism widely called *C. miniata* must be furnished another name, and *C. phoenicea* is the oldest found to date. Because I now consider the taxon best placed in *Clavaria* (not *Clavulinopsis*, cf. Petersen, 1978), no new combination is required.

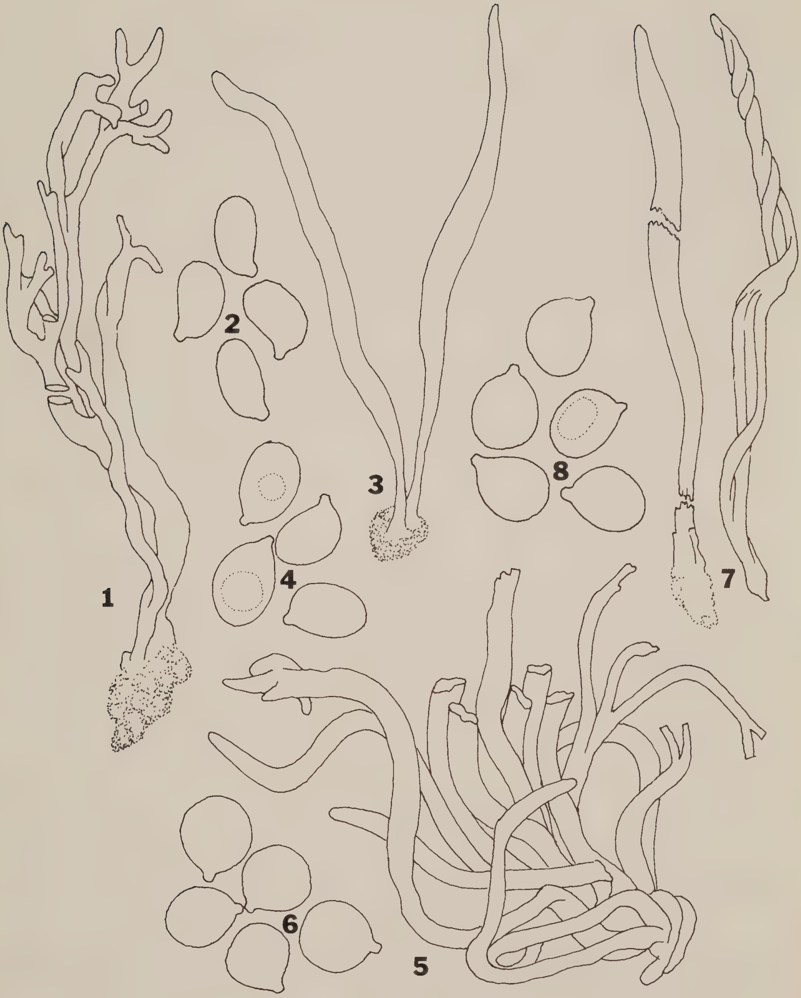
The type of *C. miniata* is a specimen of *C. aurantia* var. *macrospora* Petersen (1980), which also occurs in Africa. Although Berkeley's epithet is older, the younger name has priority at the varietal rank, so again no new combination is required.

Clavaria spiralis Junghuhn. 1838. Verh. Bot. gen. Kunst. Wetensch. 17(3): 32.

Type: L - herb. Junghuhn, Kebo-Koening, Java, May, leg. Junghuhn, s.n.

Fruitbodies (Fig. 7) at least 4, up to 8 cm high, up to 5 mm broad, simple, narrowly fusiform in the shape of a single club of *Ramariopsis fusiformis*. Stipe portion pale, perhaps whitish, minutely furfuraceous where exposed, involving some soil, but without a basal pad or mat. Club opaque, now split longitudinally and twisted in a spiral pattern (? in drying); apex narrowly rounded.

Tramal hyphae hyaline, thin-walled, clamped, loosely



Figs. 1, 2. *Clavaria alcicornis*. 1. Fruitbody. 2. Spores. Figs. 3, 4. *Clavaria amoena*. 3. Fruitbodies. 4. Spores. Figs. 5, 6. *Clavaria phoenicea*. 5. Fruitbodies. 6. Spores. Figs. 7, 8. *Clavaria spiralis*. 7. Fruitbodies. 8. Spores.

parallel; gloeoplerous hyphae occasional, not inflated. Basidia 60-70 x 7.5-9 µm, clavate, clamped, (2)-4-sterigmate.

Spores (Fig. 8) 5.9-6.7 x 5.1-5.9 µm ($\underline{E}$ = 1.06-1.21; $\underline{E}^m$ = 1.15; $\underline{L}^m$ = 6.15 µm), subglobose, thin-walled; contents granular; apiculus short, papillate.

In spite of incorrect attribution of fruitbody color (white), Corner (1950: 388-390) was correct in his perception of the taxon in what he knew as *Clavulinopsis*. Junghuhn (ibid.) twice stated "sulphurea", and accompanied the specimen with some paint streaks now impossible to interpret but not showing either white or yellow colors. In view of later developments, however, most of Corner's conjecture on color ranges and taxonomic placement must be taken with different names throughout.

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PRELIMINARY STUDIES IN THE GENERA RUHLANDIELLA, SPHAEROSOMA, AND SPHAEROZONE (ORDER PEZIZALES)

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ABSTRACT

The genera *Ruhlandiella* Hennings descr. emend., *Sphaerosoma* Klotzsch, and *Sphaerozone* Zobel are circumscribed. *Ruhlandiella berolinensis* Henn. descr. emend., *Sphaerosoma fuscescens* Klotzsch, and *Sphaerozone ostiolatum* (Tul. & Tul.) Setchell are described. A survey and a key are given for genera of the family Pezizaceae which have globose, hyaline to brownish ascospores and amyloid asci.

INTRODUCTION

During a study of the genus *Boudiera* Cooke, a number of additional taxa from the genera *Sphaerosoma* Klotzsch and *Plicaria* Fuck. emend. Boudier were also examined (Dissing and Schumacher, 1979). In the same period material collected in the Canary Islands was only tentatively named *Ruhlandiella hesperia* Setchell by Korf (Discomycete Flora of Macaronesia labels, unpublished), because the status of the genus *Ruhlandiella* Hennings was at that time uncertain. After preliminary discussions at Cornell University in 1977 the authors decided to take up studies of types and other authentic collections of species in the above genera, i.e., species with globose spores and with pulvinate to globose fruitbodies. A grant from the University of Copenhagen to the junior author made preliminary investigations in Copenhagen possible. The genus *Boudiera* was circumscribed with 6 species (Dissing and Schumacher, 1979) and in the present paper a survey is given for the monotypic genera *Ruhlandiella* Hennings descr. emend. and *Sphaerozone* Zobel, and for *Sphaerosoma* Klotzsch with two species.

Some discoid to cupulate species related to the genus *Plicaria* are treated elsewhere by Dissing and Pfister (1981), who erect the genus *Scabropezia* for species intermediate between *Plicaria* and *Pachyphloeus* Tul. A possible relationship among these genera is shown in FIG. 1.

It seems natural to place genera with globose, hyaline to pale brownish spores and amyloid asci in the family Pezizaceae (Korf, 1972), irrespective of whether violent discharge occurs (cfr. Trappe, 1979); the genus *Sphaerosoma*, also treated here, has nonamlyoid asci and is considered a member of the family Pyronemataceae (see below, page 297).

The main distinguishing characters among the taxa dealt with are summarized in the following key.

KEY TO THE GENERA TREATED

1. Asci J+ 2
1. Asci J- 7

    2. Fruitbodies pulvinate to subglobose 3
    2. Fruitbodies disc-shaped to cupulate 6

3. Asci irregularly disposed in one or more cavities in the subglobose fruitbody ....**Pachyphloeus**
3. Asci in a distinct hymenium together with paraphyses 4

    4. Asci protruding at maturity; inner and outer excipula distinguishable ....**Boudiera**
    4. Asci exceeded by the paraphyses at maturity; excipulum of one type of cell 5

5. Asci evanescent; paraphyses with a gelatinous sheath ....**Ruhlandiella**
5. Asci persistent; paraphyses without a gelatinous sheath ....**Sphaerozone**

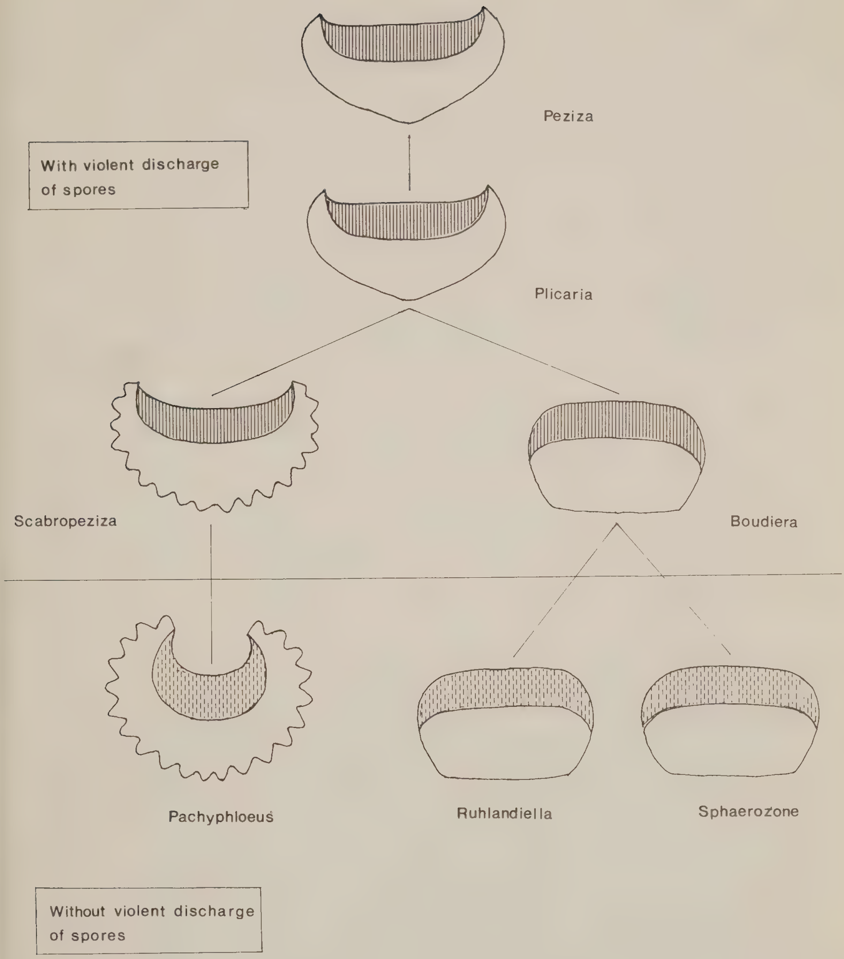
Peziza
With violent discharge of spores
Plicaria
Scabropeziza
Boudiera
Pachyphloeus
Ruhlandiella
Sphaerozone
Without violent discharge of spores

FIGURE 1. Possible relationships among genera of the family Pezizaceae with globose spores and amyloid asci. Genera with violent discharge of spores (above the line) as well as genera without such discharge (below the line) are included.

The genus Plicaria, with globose spores, is considered intermediate between Peziza, with ovoid spores, and Scabropezia and Boudiera, with globose spores. Emphasis on characters of the anatomy and morphology of the fruitbodies implies two different lines of further development. Types of fruitbodies schematic.

6. Outer surface of the apothecium prominently pustulate, composed of aggregates of globose cells; occurring on soil and decaying wood. **Scabropezia**
6. Outer surface of the apothecium glabrous or furfuraceous, composed of globose cells intermixed with broad hyphae; occurring on burnt areas ....**Plicaria**

7. Fruitbodies pulvinate; asci and paraphyses in a distinct hymenium; spores with dextrinoid ornamentation in Melzer's Reagent ....**Sphaerosoma**
7. Fruitbodies subglobose; asci irregularly disposed in one or more cavities; spores with cyanophilic ornamentation in cotton blue ....**Pachyphloeus**

THE GENUS RUHLANDIELLA (PEZIZACEAE)

RUHLANDIELLA Hennings, Hedwigia 42: (24). 1903, descr. emend. Dissing & Korf. Monotype: *Ruhlandiella berolinensis* Hennings, Hedwigia 42: (24). 1903.

= *Tremellodiscus* Lloyd, Mycol. Writings 7: 1363, pl. 344, fig. 3260. 1925 (without description). Monotype: *Spragueola mucida* Rodway, Pap. & Proc. Roy. Soc. Tasmania 1919: 114, pl. 26. 1920.

Fruitbodies pulvinate to brain-like. Excipulum of globose to angular, thick-walled cells. Asci cylindrical to clavate, weakly amyloid all over, without operculum; ascus wall evanescent. Paraphyses septate, branching, with a conspicuous gelatinous sheath; paraphyses distinctly exceeding asci in length. Ascospores globose, at first bi- to tri-seriate, hyaline, later uniseriate, with a pale brownish, strongly cyanophilic ornamentation.

ACCEPTED SPECIES

1. RUHLANDIELLA BEROLINENSIS Hennings, Hedwigia 42: (24). 1903, descr. emend. Dissing & Korf. N
type specimen: Mycoflora of Macaronesia 1.
(CUP); isoneotype (C); additional isoneotyp
to be issued in Korf & Gruff, Discomycetes Exsi
cati No. 84.

= *Ruhlandiella hesperia* Setchell, Univ. Calif. Publ. Bot. 4: 116. 1910.

≡ Sphaerosoma hesperium (Setchell) Seaver, North Amer. Cup-fungi (Oper.) 51. 1928.

= Spragueola mucida Rodway, Pap. & Proc. Royal Soc. Tasmania **1919**: 114. 1920.

≡ Tremellodiscus mucidus (Rodway) Lloyd, Mycol. Writings **7**: 1363. 1925 (the generic name Tremellodiscus not validly published, without diagnosis or description).

FIGS. 1-5.

Fruitbodies (0.5-) 1-3 cm broad, hemisphaeric to subglobose, with a convoluted to brain-like surface with irregular cavities inside, consistency rather cartilaginous, not brittle.

Excipulum up to 700 μm thick, varying greatly in thickness. Individual cells rounded to angular, mostly 35-100 μm diam, but cells up to 125-150 μm diam are seen in some sections; walls 2-4 μm thick, cyanophilic, with circular connections between the cells; no distinction between inner and outer excipula, but towards the base the cells generally smaller. Colorless anchoring hyphae 5-8 μm broad.

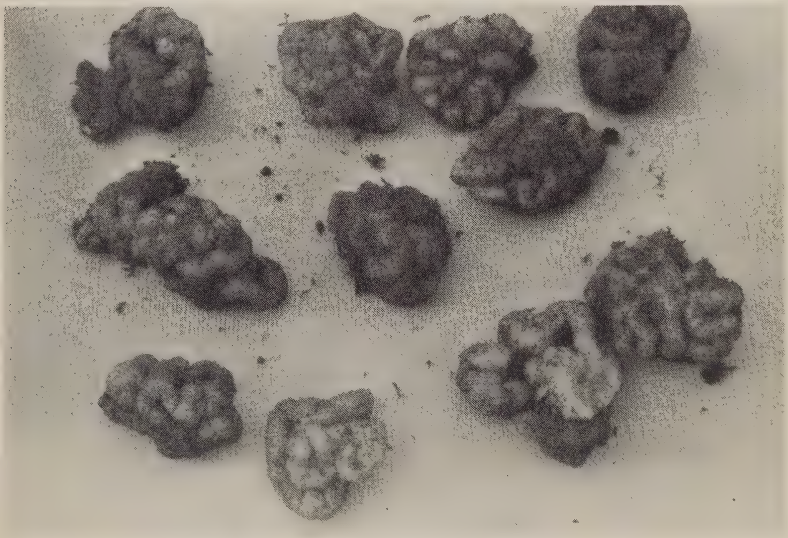

FIGURE 2. Ruhlandiella berolinensis. Fresh fruitbodies. Mycoflora of Macaronesia 1230 (Neotype). X 1.

Subhymenium varying, up to 120 μm thick; individual cells smaller than in the excipulum, towards the hymenium often forming small clusters.

Young asci broadly cylindrical, up to 320 μm long, 26-33 μm broad, thin-walled, weakly amyloid all over, and with strongly dextrinoid contents; as the spores mature the ascus wall seems to disappear.

Paraphyses 2.5-3.5 μm broad, gradually thickened above to 10-17 μm, with a characteristic, 3-4 μm broad gelatinous sheath, septate, branching from the base where they develop from cells not covered by a sheath (FIG. 5c); sometimes with backward pointing side branches, mostly curved above, 380-420 μm long, exceeding the asci by 60-100 μm.

Ascospores globose, 17.2-18.8-20.5 μm broad, exclu-

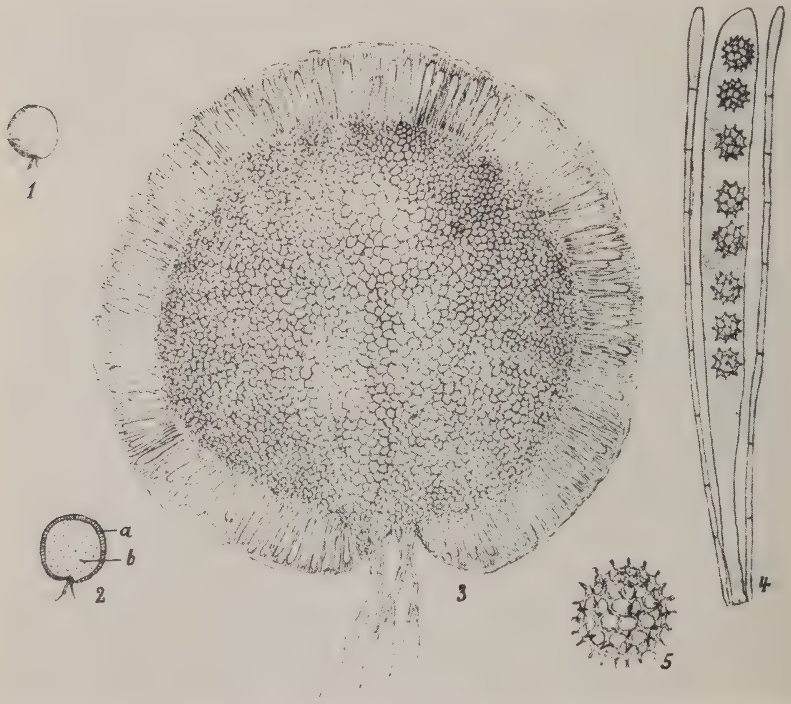

FIGURE 3. *Ruhlandiella berolinensis*. Reproduced from Hennings (1903), slightly reduced. 1. Fruitbody, natural size. 2. Section of fruitbody, a. hymenium, b. excipulum. 3. Section, magnified. 4. Ascus with paraphyses. 5. Spore, magnified.

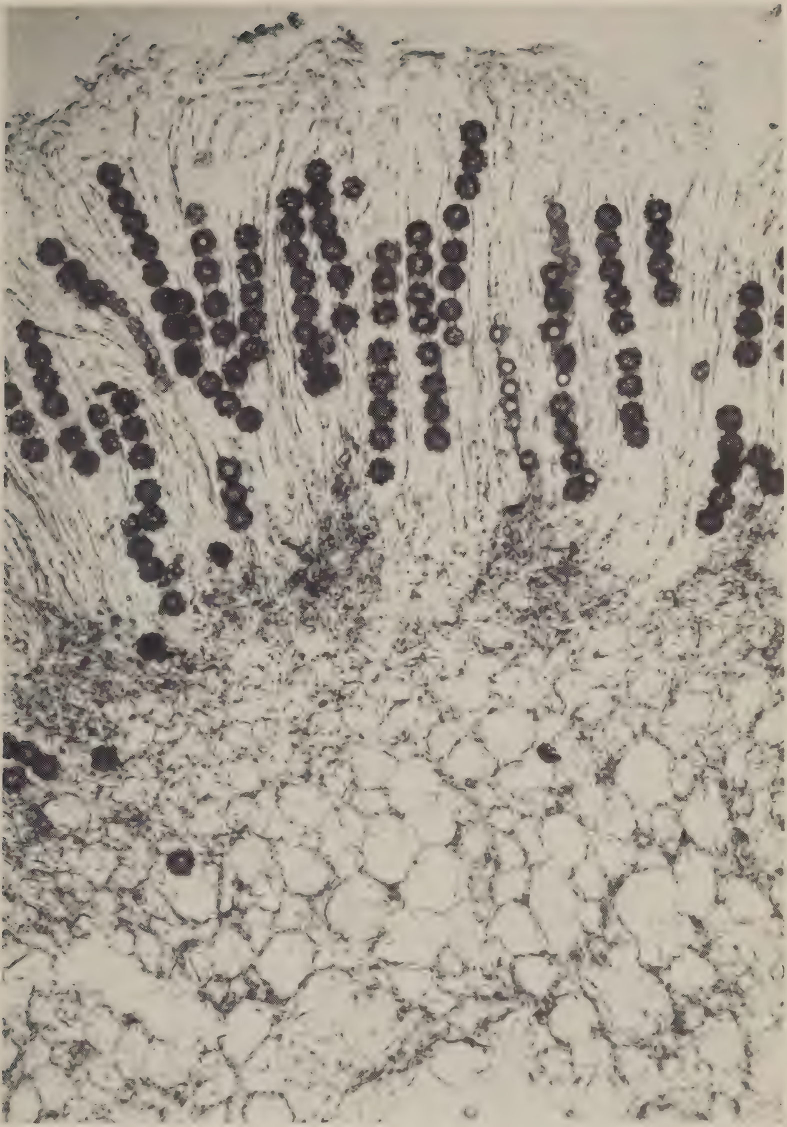

FIGURE 4. *Ruhlandiella berolinensis*.
Section in cotton blue, MM 1230 (Neotype). X 162.

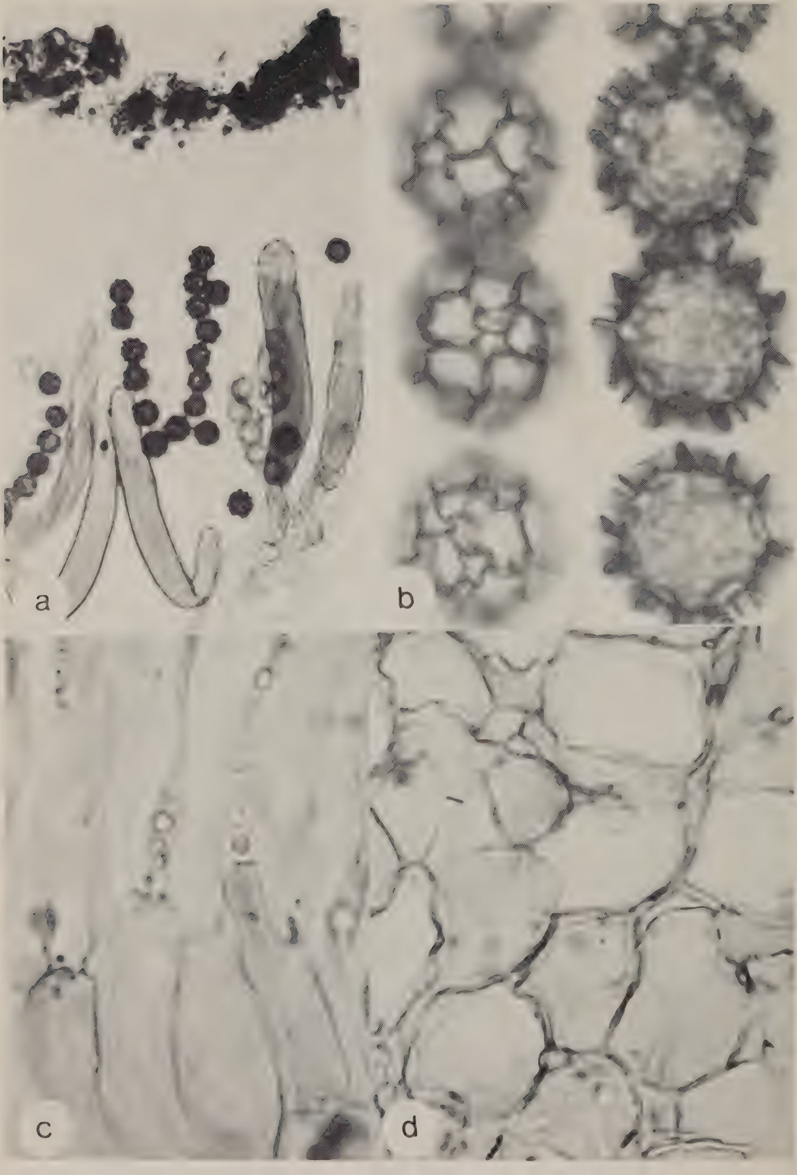

FIGURE 5. Ruhlandiella berolinensis. a. Upper part of hymenium, in Melzer's Reagent; only young asci with visible walls; paraphyses considerably exceeding the asci and the mature spores. b. Mature

sive of the ornamentation which is 3.2-4.0 µm high. Spores at first bi- to tri-seriate, hyaline, with one guttule, rarely with a de Bary bubble, smooth, later reticulate, becoming brownish, finally uniseriate, deeply reticulate-areolate, reticulation irregular, with sharp ridges, areolae 3-6 µm broad, the ornamentation strongly cyanophilic in cotton blue, staining yellowish-brown in Melzer's Reagent.

MATERIAL EXAMINED:

U.S.A.: California, Berkeley, ad terram sub foliis Eucalyptus, ii.1903, N. L. Gardner (holotype of Ruhlandiella hesperia, UC 123152).

MACARONESIA: Canary Islands, Tenerife, burn site along road in Eucalyptus grove at km mark 14, Bosque de la Esperanza, 29.xii.1976, R. P. Korf, R. Fogel, G. L. Hennebert, L. M. Kohn (Mycoflora of Macaronesia 1230, Neotype of Ruhlandiella berolinensis designated here, CUP; isoneotype, C).

AUSTRALIA: Tasmania, vii.1921, L. Rodway [authentic material of Spragueola mucida, redet. C. G. Lloyd as Tremellodiscus mucidus (BPI-Lloyd 15488, CUP 58186 [slide])].

DISCUSSION:

The directors of the herbaria in Botanischer Garten und Botanisches Museum, Berlin-Dahlem (B) and in the Botanic Institutes of the Polish Academy of Sciences, Krakow (KRAM) have kindly informed us that there is no material left of Ruhlandiella berolinensis. The ample Macaronesian material has therefore been selected to serve as neotype.

For a long time we found it difficult to come to a definite opinion on Hennings's taxon, and we thought it difficult to imagine that it could be identical with Setchell's R. hesperia. Several important characters are lacking in Hennings's description, viz., that the asci are amyloid, and the omission of mention or illustration (cfr. FIG. 3) of the characteristic gelatinous

spores, in cotton blue. c. Paraphysis bases with a conspicuous gelatinous sheath, arising from non-sheathed subhymenial cells below, with firm walls, in water. d. Excipular cells, in water. a-d, MM 1230 (Neotype). a, X 162; b-c, X 1085; d, X 455.

sheath on the paraphyses.

When Lloyd's description of Tremellodiscus mucidus was rediscovered (by RPK) and authentic material of this taxon proved to be identical with R. hesperia, the range of distribution of this species was suddenly extended from California and the Canary Islands to cover also Australia. Both the Californian and the Canary Islands collections had been taken in association with Eucalyptus, an Australian tree not native to either area.

Though Hennings's collection had been taken in a Berlin greenhouse, it was very probably with plants imported living from Australia ("Neuholländerhaus" !). After a careful re-reading of Hennings's description, and perhaps especially after an examination of his drawings (FIG. 3), in which the paraphyses are shown much longer than the asci (in FIG. 3, 3, but erroneously shown equalling the asci in FIG. 3, 4), we decided that it is by no means impossible that R. berolinensis and R. hesperia are identical. It is also important to remember that Rouppert (1910), after having studied the original material of R. berolinensis (loc. cit., p. 86) concluded it was identical with Sphaerosoma fuscescens (in his sense, i.e., with amyloid asci). Rouppert also emphasized that the spores are reticulate, not "reticulato-verrucoso," "netzig-warzig," as described by Hennings.

We assume that the current world-wide distribution of Ruhlandiella berolinensis reflects the movement of living higher plants from Australasia by man's intervention, whereby this discomycete was introduced.

Five years after Hennings described Ruhlandiella, he (Hennings, 1908) described another, even tinier, hemisphaeric discomycete in another, monotypic new genus, Exogone, which he placed close to Ruhlandiella. Ever since von Höhnel (1911) treated Exogone as a synonym of Agyrium, without even examining any material, it has apparently never been considered seriously. We disagree with von Höhnel's conclusions, and suspect that this is indeed a member of the Pezizales, for no Agyrium would have marked ascospores, nor spores of such dimensions. What Exogone really is remains a mystery: it has biseriate ascospores (but so does Ruhlandiella in youth). If Hennings once again failed to apply an iodine test (no reaction or lack thereof is mentioned in the description), and if he again missed noting a gel sheath around the paraphyses, it could represent a second species of *Ruhlandiella*. We are attempting to discover if any of the type material of *Exogone kaiseriana* Hennings still exists; if such material can be discovered, we shall comment further in another paper.

Peziza whitei (Gilkey) Trappe also has paraphyses embedded in a gelatinous sheath. Very well-preserved material was most generously provided by G. Beaton from Australia [Australia, Victoria, entrance to Erskine Falls, track near Lorne, 14.vii.1976, K. & G. Beaton **217b** (C, FH)]. Characters of the spores and the two-layered excipulum revealed a clearly non-congeneric taxon. Trappe (**1975**) has discussed the nomenclature of that species.

THE GENUS SPHAEROSOMA (PYRONEMATACEAE)

SPHAEROSOMA Klotzsch in A. Dietrich, Flora regni borussici **7**: pl. 467. 1839. Monotype: *Sphaerosoma fuscescens* Klotzsch in A. Dietr., loc. cit.

≡ *Sphaerozosma* Corda, Anleit. Stud. Mykol. 109. 1842 (lapsus calami?) non *Sphaerozosma* Corda 1835 (Desmidiaceae: pre-starting-point). Monotype: *Sphaerosoma fuscescens* Klotzsch in A. Dietr., Fl. boruss. **7**: pl. 467. 1839.

≡ *Sphaerosoma* Klotzsch subg. *Eusphaerosoma* Rouppert, Bull. Int. Acad. Sci. Cracovie, Cl. Sci. Math. **1909**: 81. 1910. Type (implied): *Sphaerosoma fuscescens* Klotzsch in A. Dietr., loc. cit. (misapplied).

ACCEPTED SPECIES

1. SPHAEROSOMA FUSCESCENS Klotzsch in A. Dietr., Fl. boruss. **7**: pl. 467. 1839.

≡ *Sphaerozosma fuscescens* (Klotzsch) Zobel in Corda (ut "Klotzsch"), Icon. fung. **6**: 52. 1854.

MISAPPLICATIONS: *Sphaerozosma fuscescens* sensu Zobel et Corda, Icon. fung. **6**: 52, pl. 11, fig. 100. 1854 = *Sphaerozone ostiolatum* (Tul. & Tul.) Setchell; *Sphaerosoma fuscescens* sensu Schroeter in Cohn, Krypt.-Fl. Schlesiens **3**(2)[i]: 31. 1893 = *Sphaerozone ostiolatum* (Tul. & Tul.) Setchell;

Sphaerosoma fuscescens sensu Rouppert, Bull. Int. Acad. Sci. Cracovie, Cl. Sci. Math. 1909: 84-87. 1910 (p.p.? asci amyloid) = *Ruhlandiella berolinensis* Hennings; *Sphaerosoma fuscescens* sensu Korf (1972, 1973) (asci amyloid) = *Ruhlandiella berolinensis* Hennings.

FIGS. 1, 6.

Fruitbodies subglobose, without margin; hymenial surface even or convoluted; at first whitish all over, later brownish.

Excipulum in rehydrated material composed of globose to angular, thick-walled cells 15-30 μm broad. In neither 5% aqueous KOH nor 25% NH_4OH was it possible to make the cells swell up to their natural size or shape.

Hymenium 330-380 μm high; asci normally 8-spored, 26-33 μm broad, cylindrical to clavate, rounded above, gradually narrowing below, non-amyloid, contents dextrinoid in Melzer's Reagent.

Paraphyses septate, straight, only slightly enlarged above to 5-6 μm broad, exceeding or equalling the asci in length, without a gelatinous sheath.

Ascospores at first bi- to tri-seriate, smooth, when mature colorless, uniseriate, globose, 17.2-19.8 μm in diam exclusive of the 2-3 μm high ornamentation of delicate, irregular, angular meshes of the reticulum which is strongly dextrinoid in Melzer's Reagent but only weakly cyanophilic in cotton blue, areolae mostly 2-4 μm diam. Spores with one large, central guttule; de Bary bubbles not observed.

MATERIAL EXAMINED:

GERMANY: Berlin, Grünewald, Botanical Garden, on soil between Calluna vulgaris and Pyrola spp., autumn (holotype K; isotype, S-Sydow).

DISCUSSION:

Gamundí (1976) studied material of *Sphaerosoma fuscescens* from Kew (K), and found the ascus to be non-amyloid in Melzer's Reagent. Our studies of the same material from Kew (RPK) and from Stockholm (HD) confirm Gamundí's observations. No amyloid reaction can be seen even if the material is pre-treated in strong solutions of KOH or NH_4OH (cfr. Kohn & Korf, 1975; Nannfeldt, 1976).

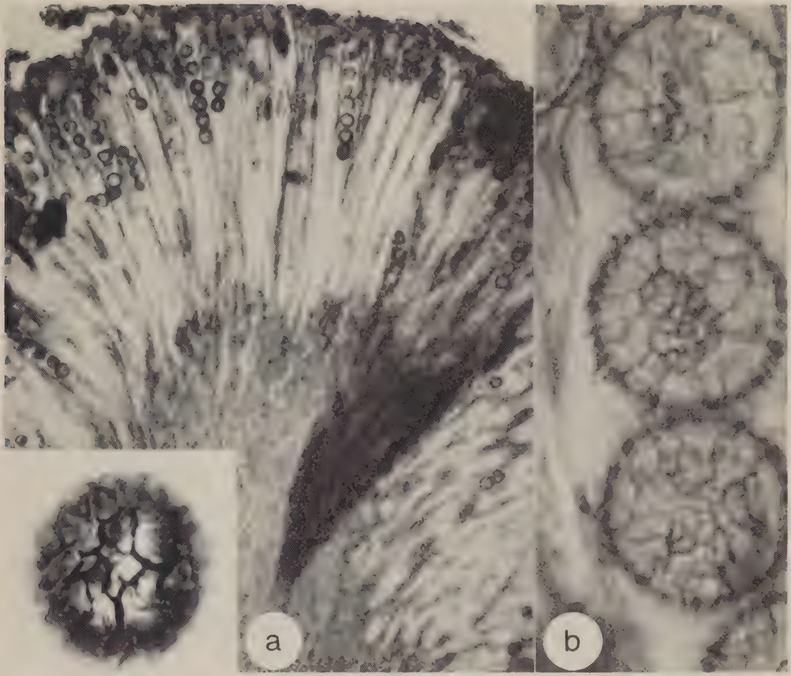

FIGURE 6. Sphaerosoma fuscescens. a. Section, in cotton blue, with persistent asci of about the same length as the paraphyses; because of the poor condition of the material, no details of the excipulum are revealed; insert: spore in cotton blue. b. Spores, in Melzer's Reagent. a, from isotype (S), X 114, insert X 1085; b, from the holotype (K), X 2150.

Korf (1972, 1973) followed the concept of Rouppert (1910), who considered Sphaerosoma a genus with amyloid asci. Consequently Korf placed the genus in the family Ascobolaceae, a disposition which cannot be supported now. His placement of Svrcekia Kub. in synonymy is also thus incorrect, for it, too, has amyloid asci.

Gamundí (1976) provisionally considered the genus to be a member of the Humariaceae, tribe Otideeae, because it "... shows certain affinities with Barlaeina and Jafneadelphus." We suggest a similar arrangement with Sphaerosoma replacing the generic name Sphaerozone in Korf's (1972, 1973) classifications, in the family Pyronemataceae Corda emend. Korf, subfamily Ascodesmidoideae Brumm. emend. Korf.

It should be borne in mind, however, that both Gamundí and we have only examined tiny fragments of a very old fruitbody, probably poisoned with mercuric chloride, and therefore studies of fresh material are needed before the true systematic position of this genus can be evaluated. Because of the condition of the material studied, we have not been able to determine whether opercula are present or not in the asci.

We feel, however, that the cylindric asci, normally with 8 uniformly sized ascospores, and normally with strongly dextrinoid contents, indicate a forcible discharge of ascospores, i.e., the presence of an operculum. The straight, septate, non-clavate paraphyses not or only slightly exceeding the asci may further support our view.

The generic name Sphaerozosma Corda 1842 must be considered an obligate nomenclatural synonym (if, indeed, it is not merely a slip of the pen). In 1854 Corda again used the name Sphaerozosma (Corda, 1854: pl. 11, fig. 100), and at the base of the illustration lists "Sph. fuscescens." Let it be noted that we consider this plate unquestionably illustrates Sphaerozone ostiolatum (Tul. & Tul.) Setchell, which we do not consider congeneric with Sphaerosoma fuscescens. Whether the 1854 plate represents another lapsus calami is unclear. Zobel, who prepared the text material for this volume, reintroduced the generic name Sphaerozosma Corda, and referred to the sole species as "Sphaerozosma fuscescens Klotzsch". We have adopted the authority as "(Klotzsch) Zobel in Corda" in our synonymy, acknowledging here that if the "Sph." of Corda's plate is Sphaerozosma and not Sphaerosoma, the correct author citation should perhaps be Sphaerozosma fuscescens (Klotzsch) Corda for this obligate synonym. In any case, it is certain that Corda's later misidentification has been the cause of much of the confusion in the literature in the application of the generic names Sphaerosoma, Sphaerozosma, and Sphaerozone.

Rouppert (1910) divided the genus into two subgenera on the basis of spore color. Sphaerosoma subg. Eusphaerosoma included hyaline-spored species, some with amyloid asci (including his misidentified material of S. fuscescens), one with non-amyloid asci. Sphaerosoma subg. Tulasnia included a single, brown-spored species which we now refer to Sphaerozone (below).

Gamundí (1976) considered the type specimen of Sphaerosoma fuscescens cited above to be a "neotype," probably because the packet data is fragmentary.

2. SPHAEROSOMA TRISPORA McLennan & Cookson, Proc. Roy. Soc. Victoria **38**: 73. 1926.

Gamundí (1976) studied this species and considered it congeneric with Sphaerosoma fuscescens.

EXCLUDED SPECIES

3. SPHAEROSOMA OSTIOLATUM Tul. & Tul. 1851 = Sphaerozone ostiolatum, see p. 303.

4. SPHAEROSOMA FRAGILE Hesse 1885 = Sphaerozone ostiolatum, see p. 303.

5. SPHAEROSOMA JANCZEWSKIANUM Rouppert, Bull. Int. Acad. Sci. Cracovie, Cl. Sci. Math. **1908**: 649. 1909.

MATERIAL EXAMINED:

Two slides, according to notes on the envelope collected and identified by Rouppert, no locality, no date, presumed holotype (KRAM 2467).

DISCUSSION:

The ovoid, delicately echinulate spores (see also Rouppert, loc. cit., fig. 6) together with the "jaune orange" colors of the fruitbodies indicate a species close to if not identical with Lamprospora ovalispora (Svrček & Kub.) Eckbl.

6. SPHAEROSOMA TASMANICA Rodway, Pap. & Proc. Roy. Soc. Tasmania **1919**: 115. 1920.

MATERIAL EXAMINED:

AUSTRALIA: Tasmania, Cascade Estate, Hobart, vii. 1919 (Holotype, HO; isotype (slide), CUP 48858).

Excipulum two-layered; asci operculate, non-amyloid even after rehydration in 10% aqueous KOH; ascospores ellipsoid, with irregularly disposed warts or spines, or with longitudinal ridges; ornamentation cyanophilic in cotton blue.

DISCUSSION:

Like Burdsall (**1968**: 521), we have no opinion on the true relationships of this interesting species, but characters of the spores and asci may indicate a relationship to the genus *Dingleya* Trappe (Trappe, **1979**: 331).

7. SPHAEROSOMA ALVEOLATUM McLennan & Cookson, Proc. Roy. Soc. Victoria **35**: 153. 1923.

DISCUSSION:

S. alveolatum has, according to the description, amyloid asci. Gamundí (**1976**: 347) considered it as belonging to the genus *Plicaria*, whereas Dissing & Schumacher (**1979**: 103) referred it to the genus *Boudiera*.

8. SPHAEROSOMA HESPERIUM (Setchell) Seaver 1928 = *Ruhlandiella berolinensis*, see p. 290.

9. SPHAEROSOMA VIOLACEUM Svrček, Stud. Bot. Čechoslov. **10**: 155. 1949.

DISCUSSION:

According to the description the asci are amyloid. The description and illustrations (loc. cit., figs. 1-3) indicate a taxon close to *Sphaerozone ostiolatum*.

THE GENUS SPHAEROZONE (PEZIZACEAE)

SPHAEROZONE Zobel in Corda, Icon. fung. **6**: 53. 1854. Monotype: *Sphaerosoma ostiolatum* Tul. & Tul. ≡ *Sphaerozone tulasnei* Zobel.

≡ *Sphaerosoma* Klotzsch subg. *Tulasnia* Rouppert, Bull. Int. Acad. Sci. Cracovie, Cl. Sci. Math. **1909**: 81. 1910. Monotype: *Sphaerosoma ostiolatum* Tul. & Tul.

MISAPPLICATIONS: Sphaerozone sensu Korf, Mycologia **64**: 982. 1972; in Ainsworth, et al., The Fungi **4A**: 270. 1973 (asci non-amyloid); sensu Beaton & Weste, Trans. Brit. Mycol. Soc. **71**: 164. 1978 (asci non-amyloid, ascospores ellipsoid).

ACCEPTED SPECIES

1. SPHAEROZONE OSTIOLATUM (Tulasne & Tulasne) Setchell, Univ. Calif. Publ. Bot. **4**: 114. 1910.

≡ Sphaerosoma ostiolatum Tul. & Tul., Fungi Hypogei 184, pl. 19, fig. 1. 1851.

≡ Sphaerozone tulasnei Zobel in Corda, Icon. fung. **6**: 53. 1854 (gratuitous name change).

= Sphaerosoma fragile Hesse, Jahrb. Wiss. Bot. **16**: 251, pl. 6, fig. 1-6. 1885.

FIGS. 1, 7, 8.

Fruitbodies brownish, globose, gibbous to convolute, with a more or less distinct opening leading into a central cavity.

Excipulum of globose to angular cells, most of which are 15-50 μm broad with 1.0-2.5 μm thick walls; not possible to distinguish between the inner and outer excipulum, nor is a subhymenium distinguishable.

Hymenium, as measured from the bases of the deepest asci to the apices of the paraphyses 420-475 μm high. Asci persistent, 280-325 μm long, 24-34 μm broad, weakly amyloid the whole length, attenuate above, with a forked base; no operculum seen.

Paraphyses straight, septate, with weakly cyanophilic contents, exceeding the asci by 30-60 μm, varying greatly, sometimes indistinguishable from the excipular cells, 8-30 μm broad above, often branching below where they are 5-14 μm broad.

Ascospores globose, 16.5-20.0 μm broad exclusive of the ornamentation of irregular, blunt or angular warts 3.0-6.0 μm high; spores at first hyaline, irregularly disposed, later reddish brown, uniseriate; mostly 5-7 spores develop in each ascus, but asci with only 1 or 2 normal spores are also seen; de Bary bubbles rarely developed.

MATERIAL EXAMINED:

GREAT BRITAIN: Near Bristol, without date, but "M.

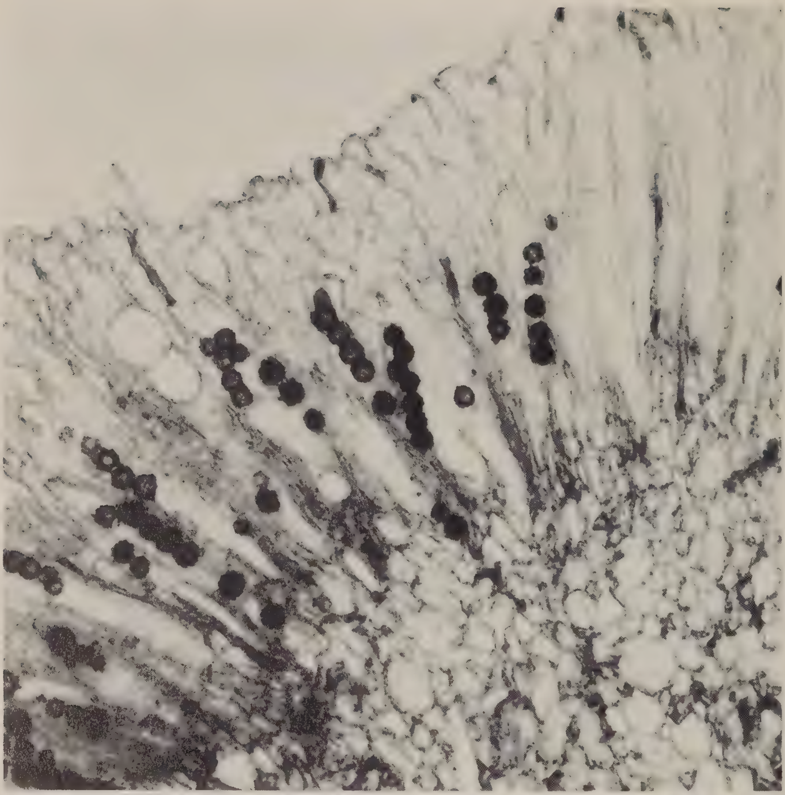

FIGURE 7. Sphaerozone ostiolatum. Section in cotton blue, hymenium not definitely delimited from excipulum, clavate paraphyses strongly exceeding the asci which contain an irregular number of spores. Ade s.n. (S-Rehm), X 162.

Broome dedit 21 janv. 47" is added with a pencil on the small envelope (presumed holotype, PC).

GERMANY: Zwischen Laub im Hartwald bei Brückenau, 16.x.1912, Ade s.n., ut Sphaerosoma fragile (S-Rehm).

DISCUSSION:

The presumed holotype of Sphaerozone ostiolatum consists of several brownish, tiny fragments less than 1.5 mm broad. The above description is primarily based on Ade's collection labelled Sphaerosoma fragile. The ascospores are identical in the two collections, and all microscopic characters beautifully match Tulasne's

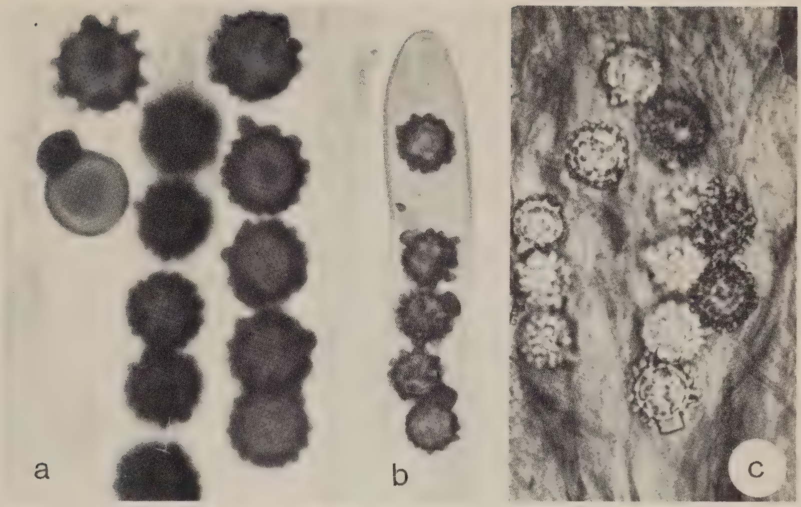

FIGURE 8. Sphaerozone ostiolatum. a. Ascospores, in cotton blue. b. Ascus, with 5 irregular spores, in cotton blue. c. Ascospores in Melzer's Reagent. a-b, Ade s.n. (S-Rehm); c, presumed holotype (PC). a, X 650; b-c, X 455.

attractive illustrations (loc. cit.). The director of the Instytut Botaniczny, Uniwersytetu Wrocklawskiego, Wrocklaw (WRSL) has kindly informed us that there is no material left of Sphaerosoma fuscescens Klotzsch sensu Schroeter, but Schroeter's (1893) description leaves no doubt that what he had was Sphaerozone ostiolatum instead. Discovery of an amyloid ascus reaction in Sphaerozone, for which no evidence was previously reported in the literature, makes Korf's (1972, 1973) treatments of the genus as having non-amyloid asci an error which cannot be maintained.

EXCLUDED SPECIES

2. SPHAEROZONE ELLIPSOSPORUM Cribb, Univ. Queensland Dept. Bot. Pap. 4: 36. 1960.

Cribb (1960) did not indicate whether the asci are amyloid or not, and no reaction was mentioned by Beaton and Weste (1978) when they examined the tiny remaining fragments of an isotype specimen. The ellipsoid spores will exclude this from Sphaerozone in our sense.

3. SPHAEROZONE ECHINULATUM Beaton *in* Beaton & Weste, Trans. Brit. Mycol. Soc. 71: 165. 1978.

This ellipsoid-spored species with nonamyloid asci must be excluded from *Sphaerozone* as now defined. The assignment to that genus presumably follows Korf's (1972, 1973) misapplication of the generic name.

ACKNOWLEDGEMENTS

A grant from the University of Copenhagen to the junior author contributed to making this cooperative project possible. He also acknowledges financial assistance of NSF Grant DEB75-23557, which permitted collection of the neotype specimen of *Ruhlandiella berolinensis*. The curators of the following herbaria kindly arranged for the loan of important material: National Fungus Collections, Beltsville (BPI); Botanical Museum and Herbarium, Copenhagen University (C); Plant Pathology Herbarium, Cornell University (CUP); Farlow Herbarium of Cryptogamic Botany, Harvard University (FH); Royal Botanic Gardens, Kew (K); Herbarium of Botanic Institutes of the Polish Academy of Sciences, Krakov (KRAM); Museum National d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris (PC); Swedish Museum of Natural History, Stockholm (S); Herbarium of the University of California, Berkeley (UC). G. Beaton provided important material from his private herbarium. D.H. Pfister, T. Schumacher, and Å. Strid made pertinent suggestions during preparation of this paper. Lene Christiansen, Niels Henry Larsen, and Karin Vestberg gave valuable technical assistance. We highly appreciate their cooperation.

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REVUE DES LIVRES

par

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THE WHOLE FUNGUS, THE SEXUAL-ASEXUAL SYNTHESIS. KANANASKIS II, Proceedings of the Second International Mycological Conference held at the Environmental Sciences Centre of the University of Calgary, Kananaskis, Alberta, Canada, September 3-13, 1977, par W. B. KENDRICK, éditeur, publié par le National Museum of Natural Sciences, National Museums of Canada et la National Kananaskis Foundation, 793 p., illustré, en 2 vols., quarto, couv. papier, 1979. Distribué par l'éditeur, W.B. Kendrick, Dept. of Biology, Univ. of Waterloo, Canada N2L 3GL. Prix $ 20.-.

Kananaskis II, seconde conférence mycologique organisée par W.B. Kendrick, huit années après la première conférence, Kananaskis I, tenue en 1969, a réuni autour de la table 24 mycologues dans le but de faire le point sur ces cent années, depuis la découverte du pléomorphisme des champignons par les Tulasnes, d'étude des champignons imparfaits et parfaits et ainsi redécouvrir le champignon dans son entité, *the whole fungus*, pléomorphe, le classer et le dénommer.

Kananaskis I (voir W.B. Kendrick, *Taxonomy of the Fungi Imperfecti*, 1971, Toronto Univ. Press), n'avait considéré que les 'champignons imparfaits' et avait atteint une haute convergence de vue sur la terminologie descriptive et la classification de leur conidiogénèse. Dès lors le pléomorphisme devait apparaître, non plus seulement comme une caractéristique troublante de ces organismes, mais comme une réalité fondamentale, extrêmement riche, et qui n'avait rien d'imparfait. Ce qualificatif, que par tradition nous leur donnions, apparut bientôt comme déplacé sinon outrageant. L'imperfection est d'avantage le fait de nos connaissances. Des termes nouveaux, proposés par Hennebert et Weresub (Mycotaxon, 6:207-211,1977), furent adoptés par la Session de nomenclature du Second Congrès international de Mycologie de Tampa, 1977: *anamorphe* pour *forme imparfaite*, *téléomorphe* pour *forme parfaite*, *holomorphe* pour le champignon dans son entièreté. Kananaskis II, qui se réunit immédiatement après le Congrès de Tampa, adopta d'emblée l'usage de ces termes. La republication de l'article mentionné et une revue du pléomorphisme des champignons depuis sa découverte par les Tulasnes, par L.K. Weresub et K.A. Pirozynski, constituent ainsi les premiers chapitres de l'ouvrage.

Les treize chapitres suivants du volume 1 et les premiers du volume 2 traitent des Ascomycètes, les suivants du volume 2 des Basidiomycètes et des Zygomycètes. Le pléomorphisme des champignons, dont l'origine remonte aux ères géologiques, a produit des types multiples de conidiogénèse et des structures variées de conidiome, dont la signification taxonomique apparaît avec évidence dans une taxonomie synthétique (holomorphique) des divers groupes de champignons. C'est ce qui ressort de chacune des études particulières présentées, chacune dans son style propre, à la Conférence. (N.B. une étude, sur les formes conidiennes des Discomycètes, par Hennebert & Bellemère est manquante et a été publiée dans Rev. Mycol.,43:259, 1979).

C'est à tel point que les anamorphes aident le taxonomiste à ajuster sa taxonomie des téléomorphes, tout comme l'appartenance des anamorphes à tel ou tel groupe de téléomorphes l'avait poussé à affiner leurs critères de différenciation. Mais l'intégration des deux taxonomies soulève le grand problème de la garantie de vérité à donner aux connections entre anamorphes et téléomorphes. Ce problème a été envisagé aussi par Kananaskis II.

W.B. Kendrick, et des membres de la Conférence, ont contribué un ensemble de listes, couvrant quelques 170 pages, des très nombreuses connections aujourdhui publiées entre anamorphes et téléomorphes d'Ascomycètes et de Basidiomycètes. Ces listes, sans doute encore incomplètes, sont les plus étendues publiées à ce jour. Elles illustrent fort bien le travail qui est à faire encore. En effet, trop souvent par le passé,l' association de formes fut prise pour une relation ontogénique et publiée sans une démonstration expérimentale. Aussi faudra-t-il, en chaque cas, s'assurer du label de vérité par une analyse critique de la littérature originale, d'ailleurs chaque fois mentionnée, ou par de nouvelles observations. En outre il s'avèrera nécessaire de vérifier ou même ajuster la nomenclature utilisée. Enfin de reconnaître, décrire et dénommer tant d' anamorphes restées indéterminées.

Enfin, l'ouvrage n'est pas qu'une suite de chapitres juxtaposés.Il est au contraire un ensemble vivant, où apparaît, à travers les discussions et les dialogues, la pensée de chacun. C'est aussi un ensemble bien lié par le "mot du Président".

W.B. Kendrick sera apprécié pour la production d'un ouvrage de cette qualité et de ce format. C'est une pièce importante de la bibliothèque de tout mycologue, qu'il soit introduit ou débutant.

XII INTERNATIONAL BOTANICAL CONGRESS, LENINGRAD, 3-10 JULY, 1975. PROCEEDINGS, par D.V. LEBEDEV, édit., 209 p., ill., couv. papier, 14 x 21, 1979.Academy of Sciences of the USSR, Leningrad NAUKA, Komarov Botanical Institute. Prix 1 p. 20 K.
LIST OF PARTICIPANTS, par D.V. LEBEDEV, édit., 248 p., 1979,Idem. Prix 95 K.

Le volume des *Proceedings* contient l'organisation et le programme du Congrès, le compte-rendu de la Session d'ouverture, les textes des conférences du Symposium général sur la conservation du monde végétal, le compte-rendu de la Session plénière de clôture, y compris les résolutions et enfin le compte-rendu des 18 Sections du Congrès.Des Sections 2 à 18, seuls les titres des communications sont relatés. Par contre, la Section 1, qui est la Session de Nomenclature, qui eut lieu du 30 juin au 4 juillet 1975, est entièrement relatée, des pages 129 à 187. Le compte-rendu donne le résultat des votes sur chacune des propositions d'amendement du Code International de Nomenclature Botanique, ainsi que les commentaires, et les annexes habituelles.

MARASMIEAE (BASIDIOMYCETES - TRICHOLOMATACEAE), par Rolf SINGER, Monographie n° 17 de Flora Neotropica, 348 p., 118 figs., octavo, couv. papier, 1976. Publication de l'Organization for Flora Neotropica, The New York Botanical Garden, Bronx, New York 10458. $ 25.-

La tribu des *Marasmieae*, sous-tribus des *Crinipellinae* et des *Marasmiinae*, les seules considérées ici, de la famille des Trocholomatacées, comprend des genres fort bien représentés dans les Tropiques et les

Néotropiques. Les *Oudemansiellinae* ont été traitées antérieurement par l'auteur (1962, 1964, 1973). L'auteur, qui a déja publié une monographie des genres *Marasmius* (1965), *Crinipellis* et *Chaetocalathus* (1942), une étude de Marasmiinées cyphelloïdes (1960) et des études préliminaires sur les Marasmiinées d'Amériques du Sud (1942, 1965), ne reprend ici que les espèces néotropicales de ces deux sous-tribus de Marasmiinées. Ces espèces appartiennent aux genres *Crinipellis* (41 espèces), *Chaetocalathus* (6), *Marasmius* (233), *Gloiocephala* (22), *Lachnella* (4), *Amyloflagellula, Flagelloscypha, Physalacria* (9), *Manuripia, Epicnaphus, Hymenogloea* et *Rimbachia*. Un portait et une notice biographique de l'auteur est ajoutée à l'ouvrage.

TRAVAUX DEDIES A GEORGES VIENNOT-BOURGIN, par la Société Française de Phytopathologie, avec préface de Jacques DELAGE, 416 p., ill., portrait de G. VIENNOT-BOURGIN, octavo, couv. papier, 1977. Institut National Agronomique, Laboratoire de Pathologie végétale, 16 rue Claude Bernard, 75005 Paris. Prix FF. 200.-

Orné en couverture de dessins de spores de 28 espèces de Micromycètes par G. Viennot-Bourgin, cette ouvrage a été composé et offert en hommage au Professeur G. Viennot-Bourgin, pour ses 50 années de recherche et d'enseignement de la pathologie végétale, à l'Institut National Agronomique de Paris. 37 contributions scientifiques y sont réunies. Elles traitent de mycologie systématique, de phytopathologie, y compris la bactériologie et la virologie, de microbiologie du sol et aussi de mycologie médicale et de mycophagie. En préface, une biographie du Maître, suivie d'une liste des 125 taxa fongiques qu'il décrivit de 1926 à 1976, ainsi que celle des genres et espèces de micromycètes qui lui furent dédiés. De plus, 8 espèces de champignons sont décrites comme nouvelles, dont trois encore lui sont dédiées: *Uromyces viennot-bourginii* Ankister et al., *Hamaspora viennotii* Durrieu, *Venturia viennotii* Morelet, *Ascobolus egyptiacus* Mouchacca, *Cortinarius pardinipes* Romagnesi, *C. earinus* Romagnesi, *C. hinnuleolus* Romagnesi et *Ustilago paspalidicola* Zambettakis.

LES DISCOMYCETES DE FRANCE D'APRES LA CLASSIFICATION DE BOUDIER, par L. J. GRELET, réimpression 1979, viii + 709 p., ill., couv. papier, octavo, Bulletin de la Société Botanique du Centre-Ouest (France), nouv. série, n° special 3. Editeur responsable R. Daunas, "Le Clos de la Lande" Saint-Sulpice-de-Royan, F-17200 Royan, France. Prix FF 260.-.

L'oeuvre de l'Abbé Grelet, dont la réimpression était tant souhaitée, comprend la description de pas moins de 190 genres et de 1285 espèces et variétés de Discomycètes, observés et décrits sur des récoltes de l'auteur ou reçues par lui. La taxonomie de Grelet est celle de Boudier. Avec la Flore analytique des Champignons supérieurs de Kühner et Romagnesi et les Hyménomycètes de France de Bourdot et Galzin, le Boudier n'étant pas à la disposition de chacun, les Discomycètes de France de l'Abbé Grelet constituent un des piliers de la mycologie française. Publié en trente parties successives dans le Bulletin de la Société Botanique du Centre-Ouest puis dans la Revue de Mycologie de 1932 à 1959, il est agréable de disposer aujourdhui de cet ensemble en un seul volume fort bien édité. De plus, un index alphabétique des noms et épithètes latines y a été ajouté. Il faut apprécier les efforts de la Société Botanique du Centre-Ouest de la France et de son Président, M.R. Daunas, à qui est dû la parution de ce livre de grande utilité.

ANNUAL REPORTS OF THE STATE BOTANIST 1868 - 1912. Volume I (1868-1877), par Charles Horton PECK, réimpression 1980, éditée par L. VOGELENZANG, avec notice biographique de C.H. Peck par R.H. Petersen, 720 p., ill., avec 1 microfiche des 7 pls. coul., octavo, relié, toilé, 1980. Boerhaavepress, p.o.box 1051, NL-2302BB Leiden Nederland. Prix du Vol. 1 Dfl. 320.-.

La réimpression de la majeure partie de l'oeuvre de Peck que constituent les *Annual Reports of the State Botanist,* couvrira 6 volumes de la même importance que le présent volume, chacun de 600 à 720 pages et incluant de 27 à 62 planches, les planches en couleurs étant reprises sur microfiches de haute qualité. Le second volume paraîtra en 1981. la réimpression est excellente, les figures au trait sont sans fracture; la reliure est bonne et de bonne toile. Ce premier volume couvre les années 1868 à 1877. Dès 1868, Peck enfin appointé pour un salaire minimal comme botaniste chargé du relevé de la flore de l'Etat de New York à Albany, explora intensément la flore mycologique de la région, la moins connue alors, et décrivit 2700 taxa nouveaux de champignons. Il monographia 28 des 50 genres d'agaricales alors couramment acceptés. Il constitua aussi à Albany un herbier mycologique qui en 1920 comprenait 33.600 specimens de champignons. Dans son introduction, R.H. Petersen montre bien la difficile convergence des intérêts de l'Administration et de ceux du scientifique que fut Charles Peck... au point de voir ses locaux occupés. De même, les *Annual Reports* étant des documents officiels devant être approuvés par la législature de l'Etat de New York, tout étant déjà imprimés, mais leur distribution étant différée, la date de leur publication effective, au sens du Code, était pour le moins incertaine. R.H. Petersen réussit heureusement, grâce à une recherche à travers la littérature de l'époque, à préciser davantage la date de publication des 48 *Annual Reports* de Charles Peck. Ainsi présentée, l'oeuvre de Peck prend toute sa valeur et son importance.

RECOGNITION AND CONTROL OF PESTS AND DISEASES OF FARM CROPS, par E. GRAM, P. BOVIEN et C. STAPEL, texte de Frank HOPE, 167 p., 120 pls. col., octavo, relié, toilé, 1980. Blandford Press Ltd, Link House, West Street, Poole, Dorset BH15 1LL, UK. Prix £ 15.-.

Ce livre est une mise à jour du *Recognition of Diseases and Pests ofFarm Crops,* des mêmes auteurs, que publiait en trois langues la maison Blandford en 1969. Les 120 planches dessinées en couleurs ou photographiées représentent 700 maladies et dégâts de plantes cultivées. Chaque planche porte sa légende. En outre, le texte qui suit les planches donne un commentaire sur chacune d'elle, précisant les caractéristiques de la maladie, de son agent et des symptômes, comme la cause des dégâts, et les moyens de lutte. La pomme de terre, la betterave et les céréales y reçoivent une particulière attention. Ce livre rendra de grands services aux phytopathologistes et aux praticiens, comme aide-mémoire dans l'identification. Cette édition n'est qu'en anglais.

THE EUKARYOTIC MICROBIAL CELL, par G.W. GOODAY, D. LLOYD et A.P.J. TRINCI, édit., Thiertieth Symposium of the Society for General Microbiology, Univ. of Cambridge, March 1980, viii + 439 p., illust., Publication de la Society for General Microbiology, Cambridge Univ. Press, Trumpington Street, Cambridge CB2 1RP UK. Prix £ 25.-.

La Société de Microbiologie Générale s'est consacrée cette fois à une réflexion sur les récents développements dans l'étude de la structure et de la fonction des organelles cellulaires des microorganismes eukaryotes, champignons, algues et protozoaires, comme elle le fit en 1978 pour les prokaryotes dans *Relations between structure and function in the prokaryotic cell*, Symposium n° 25, Cambridge, Univ. Press. Sans doute l'attention de nombreux biologistes et biochimistes s'est portée sur ces organismes comme modèles de laboratoire; cependant ces microorganismes méritent d'être étudiés pour eux-mêmes, eu égard à leur importance dans l'équilibre vital de la nature, dans la production alimentaire, pharmaceutique et biochimique, autant que par les altérations, les pollutions et les pathogénies qu'ils causent. Ce volume de 13 chapitres aborde donc successivement les chromosomes (R. Morris) et les mécanismes de la division nucléaire (J.D. Doyer et K. Vickerman), la membrane plasmatique et sa réaction aux antibiotiques (D. Kerridge), la fonction mitochondriale (D. Lloyd et G. Turner), de l'hydrogénosome (M. Müller) et des chloroplastes algaux (J. Raven), la formation et l'extension de la membrane fongique, primaire et secondaire, en relation avec la biosynthèse de la chitine (chitosomes) et d'autres polysaccharides (G.W. Gooday et A. Trinci), l'actomyosine dans la mobilité (E. Korn) la fonction des cils (M. Holwill)et la génétique des algues et levures (U. Goodenugh); enfin les mycovirus, et la régulation de la fructification chez Dictyostelium. Le livre est une heureuse synthèse des dix dernières années de recherche dont il fournit quelques 85 pages de références bibliographiques. Il permettra une information rapide et actuelle de tous ceux qui s'intéressent de près ou de loin à la physiologie et la culture de ces organismes.

PLANT DISEASES ATTRIBUTED TO BOTRYODIPLODIA THEOBROMAE PAT. par E. PUNITHALINGAM, Bibliotheca Mycologica, J. Cramer ed., Band 71, 123 p., 9 pls., 22 x 14, couv. papier, 1980. Ed. J. Cramer, FL-9490 Vaduz. Prix DM 30.- (24.-).

Il s'agit d'une compilation de la littérature phytopathologique impliquant *Botryodiplodia theobromae* dans des phénomènes pathologiques observés sur 37 plantes hôtes différentes. Près de 300 références bibliographiques ont été consultées.La synthèse des données est présentées par plante hôte. L'auteur ne prend pas parti dans les cas douteux. Une introduction explique la longue synonymie du champignon par sa grande variabilité.

MICRO-MORPHOLOGICAL STUDIES OF SOFT ROT FUNGI IN WOOD, par A.S. ZAINAL, in Bibliotheca Mycologica, J. Cramer ed., vol. 70, 177 p. 179 figs. (en 22 pls.), 22 x 14, couv. papier, 1980. Ed. J. Cramer, FL-9490 Vaduz. Prix DM 60.- (48.-).

L'auteur démontre l'existence de cavités intrapariétales due à la pénétration et l'action enzymatique de *Phialophora fastigiata* dans les fibres du bois de *Betula* sp. et de *Pinus sylvestris*. La présence de lignine n'inhibe pas l'action des enzymes cellullolytiques du champignon, mais la masque et la retarde seulement. La perforation et la digestion des différentes couches des parois des vaisseaux, des fibres et du parenchyme du bois sont abondamment illustrées par photographies au SEM et TEM. Le texte consiste essentiellement dans une revue de la littérature, un exposé des méthodes de culture et de microscopie et l'explication des figures, suivie de discussions trop souvent peu claires. On relèvera des erreurs, ne fût-ce que l'écriture "3 mm3 wood blocks" pour des cubes de bois de 3x3x3 mm. La présentation de ce travail eut beaucoup gagné à être revue par quelques spécialistes avant publication.

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NOTICE

CHANGE OF DATE OF MSA GOLDEN JUBILEE

The 50th Anniversary meeting of the Mycological Society of America will be held **August 16-21, 1981** at Indiana University, Bloomington, Indiana, USA, in conjunction with AIBS. It was previously announced that meeting dates would be August 9-14, but these dates were changed by the president of Indiana University.

The Anniversary program will include nine symposia, three invited lecturers, a banquet, contributed papers and exhibits. You are cordially invited to attend.

Jack D. Rogers, Chairman
MSA Golden Anniversary Committee

[Editorial note: the new dates conflict with those of the XIII International Botanical Congress in Sydney, Australia, particularly for the Nomenclature Sessions August 17-20. MYCOTAXON's Managing Editor has had to relinquish appointment as master of ceremonies at the anniversary banquet in view of his commitment to attend the nomenclature sessions at Sydney. Not all university presidents are equally appreciated by him!]

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LEOTIACEAE II. A PRELIMINARY SURVEY OF THE NEOTROPICAL SPECIES REFERRED TO HELOTIUM AND HYMENOSCYPHUS

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SUMMARY

The seventy-two species referred to *Helotium* or *Hymenoscyphus* and reported from the neotropics are re-examined and their current taxonomic status evaluated. A taxonomic key is provided for all accepted species, and members of the Sclerotiniaceae and *Hymenoscyphus* are fully described and illustrated; suggestions are made as to where the remainder of the species could be placed. The seventy-two species are distributed as follows: 17, no types or voucher specimens to confirm reports; Sclerotiniaceae - 24, distributed in the genera *Moellerodiscus* 5, *Lambertella* 8, *Lanzia* 7, *Poculum* 4; Leotiaceae - 26, with *Hymenoscyphus* 15, *Bisporella* 6, *Chlorencoelia* 2, *Chlorociboria* 1, *Encoelia* 1, *Phaeohelotium* 1; Orbiliaceae - *Orbilia* with 2; Operculate Discomycetes 2; 1 lichen. Several new combinations are made in both the Leotiaceae and Sclerotiniaceae, while several are placed into taxonomic synonymy.

For almost a decade and a half, I have been conducting extensive field explorations in the neotropics. Although our group has collected many groups of fungi comprehensively, we have concentrated on Inoperculate and Operculate Discomycetes found on a variety of substrata. We have gathered several hundred collections of these small fungi, and our recent emphasis has been attempting to identify the more common members of the Leotiaceae and Sclerotiniaceae. Until fairly recently, the most updated work on the fungi from this region has been by R. W. G. Dennis, who has published several scattered papers on these Discomycetes.

The chore of naming current collections is particularly difficult, since no real comprehensive treatment exists for most groups of fungi from tropical regions. Dennis's (1970) work on the fungus flora of Venezuela is an important treatment, but its scope is limited. Nevertheless, his work is still the best place to begin when attempting to identify many tropical species. Our work is further complicated because the necessary generic monographs are lacking, and even in temperate groups generic and species concepts are still vague and confusing. Identification of tropical collections of the

Helotium-Hymenoscyphus complex is an excellent example where identification is difficult; the naming of members of the Sclerotiniaceae in the neotropics in many cases is almost impossible since many species were described in other genera, and the names are hidden in genera such as *Helotium*.

Although Dennis (1964) provided an important contribution to understanding *Hymenoscyphus*, many species were placed into the genus when no type collections existed; and as is pointed out here, species were placed in the genus when in reality they are members of the Sclerotiniaceae. Recently, we have begun to report the findings of some of our field work and have been attempting to update synonymies and give descriptions and illustrations of many of the more common neotropical species (Carpenter & Dumont, 1978; Carpenter, 1981; Dumont & Carpenter, 1981; Dumont, 1981; and Haines, 1980).

The purpose of this paper is to present the findings of a preliminary survey of the species of *Helotium-Hymenoscyphus* reported from the neotropics. This study is by no means complete; it is hoped that with the aid of the taxonomic key, the descriptions and illustrations of members of *Helotium-Hymenoscyphus* and of the Sclerotiniaceae at least some of the more common species from the neotropics can now be identified and named correctly. It is further hoped that a better understanding of the genus *Hymenoscyphus* in the neotropics will begin to emerge as subsequent workers use this treatment and contribute further information to it.

The methods and terminology used here are the same as those reported by Dumont (1971). For those species which do not belong in *Helotium-Hymenoscyphus* or Sclerotiniaceae, no attempt has been made to redescribe them. Rather suggestions are made as to where the species may be better placed. No attempt is made to present full nomenclatural or taxonomic synonymies for any species. However, with those species referred to *Hymenoscyphus* or Sclerotiniaceae, the basionym will be cited. Those wishing further information are encouraged to refer to the literature cited for each species.

The following key includes the species considered. The names given are those which I accept for each taxon, and the names under that name in parentheses are those under which that taxon was actually published or reported. Since special emphasis in my recent studies have been in the Sclerotiniaceae and *Hymenoscyphus* (Leotiaceae), several of the species are keyed out only to genus, e.g., *Orbilia* spp.

Key to species reported as Helotium or Hymenoscyphus from the neotropics

1. Asci inoperculate..2.
    2. Apothecia subsessile to sessile, waxy; receptacle thin, composed of large, thin-walled, globose cells; the paraphyses knobbed; asci small; ascospores tiny..............................*Orbilia* spp.
    (See *Helotium blumenaviense*, *H. disseminatum*)
    2. Without the above combination of characters....................3.
        3. Substratal stroma present................(Sclerotiniaceae)4.

4. Ectal excipulum composed of globose to angular cells...(*Moellerodiscus*)5.

5. Apothecia in 2% KOH releasing a reddish purple dye; ascospores 5-7 x1.5-2.5µm......................................*M. fuscobrunneus*

5. Apothecia not emitting a reddish purple dye in 2% KOH..........6.

6. Paraphyses with internal light brown to dark brown pigment; ascospores 6-8(-10)x2-3.5(-4)µm..................*M. conocarpi*

6. Paraphyses without internal brown pigment; ascospores (4-)5-7 (-9)x1.5-2.5µm...................................*M. lentus*
(See *Helotium cecropiae*, *H. phlebophorum*, *H. uleanum*)

4. Ectal excipulum composed of hyphae (textura prismatica to porrecta) imbedded in a gel or not..7.

7. Ascospores less than 20µm long..............................8.

8. Paraphyses pigmented; ascospores pigmented, (6-)7-8(-10)x (2.5-)3-3.5(-4)µm..................*Lambertella spadiceo-atra*
(Also see *Helotium chromo-flavum*)

8. Paraphyses without pigment..............................9.

9. Outer surface of apothecium clothed with tightly interwoven, narrow hairs forming a mat with the details of the individual hairs difficult to observe; ascospores lightly pigmented, (9-)10-11(-12)x4-5µm................*L. lasseri*

9. Outer surface not clothed with hairs, if hairs present not interwoven, the individual hairs easily observed.......10.

10. Ascospores less than 10µm long..................11.

11. Ascospores 5-6(-11)x2-2.5µm, lightly pigmented.. ....*L. microspora*
(See *Helotium atrosubiculatum*, *H. caracassense*, *H. singeri*, *H. vile*)

11. Ascospores 5-6x2-3µm, not pigmented............ ....*Lanzia livida*

10. Ascospores 10µm or more long....................12.

12. Ectal excipulum composed of hyphae imbedded in a gel..13.

13. Ascospores biguttulate, 10-12x2-3µm; ectal excipulum composed of long, narrow hyphae (textura porrecta); on culms of bamboo..... ....*Poculum bambusae*

13. Ascospores multiguttulate, (9-)11-13x3-4µm; ectal excipulum composed of hyphae made up of brick-shaped cells (textura prismatica); on leaves.....................*P. titubans*

12. Ectal excipulum composed of hyphae not imbedded in a gelatinous matrix; ascospores (12-)13-15 (-16)x(4-)5-6(-7)µm................*L. albo-atra*

7. Ascospores more than 20µm long..............................14.

14. Ectal excipulum composed of hyphae, lacking a gelatinous matrix; apically free marginal cells slightly to greatly inflated and expanded; ascospores (20-)24-36(-60)x(2.5-)3-6(-8) µm..*L. rufocornea*
(See also *Helotium flavo-aurantium*, *H. fuscopurpureum*, *H. miniatum*, *H. subserotinum*)

3. Substratal stroma absent............................(Leotiaceae)15.

15. Ectal excipulum composed of globose to angular cells.........16.

16. Ectal excipulum composed of loosely arranged globose to angular cells, not giving rise to tomentum hyphae oriented perpendicularly to the surface of the receptacle........... ....*Encoelia* sp.

(See *Helotium lobatum*)

16. Ectal excipulum if composed of angular to globose cells, then not loosely arranged, rather tightly compact and giving rise to tomentum hyphae oriented perpendicularly to the surface of the apothecium.................................*Chlorencoelia* sp.
(See *Helotium gedeanum*)

15. Ectal excipulum composed of hyphae organized into a textura prismatica, porrecta, or intricata, no globose or angular cells present or if present then only at the base of the receptacle and/or stipe......17.

17. Apothecia aeruginous green, growing on wood and the wood stained green............................*Chlorociboria aeruginascens*
(See *Helotium aeruginosum*)

17. Apothecia not aeruginous green, substrate not stained green..18.

18. Apothecia sessile to subsessile, yellow; ectal excipulum composed of waxy, undulating hyphae oriented more or less perpendicularly or at very high angles to the surface of the apothecium and without globose cells....(*Bisporella*)19.

19. Asci J-; ascospores 0 to 1-septate, 9-14x3-5µm........ ....*Bisporella citrina*
(See also *Helotium crocinum*)

19. Asci J+; ascospores 1-septate, 8-10x1.5-2µm........... ....*B. discedens*
(See also *Helotium nigripes*, *H. pezizoideum*, *H. hyphicola*)

18. Without the above combination of characters.............20.

20. Ectal excipulum composed of hyphae extending perpendicularly to the surface of the apothecium, interwoven, frequently losing hyphal orientation, globose cells present and giving rise to tomentum hyphae oriented perpendicularly to the surface of the apothecium ....*Chlorencoelia* sp.
(See *Helotium gedeanum*)

20. Ectal excipulum if with any of the above characters, then without the clavate, tomentum hyphae............. ....(*Hymenoscyphus*)21.

21. Apothecia subsessile, substipitate, turbinate; stipe (or substipe) and base of receptacle of apothecium on the outside composed of textura angularis to textura globulosa................... ....(*Hymenoscyphus epiphyllus* group)22.

22. Apothecia occurring on wood..............23.

23. Apothecia strongly cupulate to umbilicate; ascospores (13-)15-18(-20)x(3-)4-5µm; apically free cells of the ectal excipulum cylindric, clavate, subcapitate....................*H. umbilicatus*

23. Apothecia flat or only slightly concave, not umbilicate; ascospores (16-)18-22(-24)x(4-)5-6(-8)µm; without modified apically free cells on the ectal excipulum..........*Phaeohelotium luteum*

22. Apothecia occurring on leaves, turbinate, not umbilicate; ascospores 15-18x3.5-5µm.... ....*H. epiphyllus*

21. Apothecia stipitate; stipe (or substipe, if present) composed of textura prismatica to porrecta (if any globose cells present in stipe or recep-

tacle use first choice)....................*H. caudatus* group 24.

24. Ascospores more or less equilateral, (4-)5-7(-9)x1.5-2(-2.5) µm; apothecia large, irregular in outline, umbilicate...*H. leucopsis*
(See also *Helotium cupreum*, *H. irregulare*)

24. Ascospores generally inequilateral frequently flattened on one side; apothecia not so constructed..................25.

25. Ascospores with a large "nuclear staining area" visible in phloxine, cotton blue and analine blue dyes, rarely 1-septate, (22-)26-30(-35)x4-5(-6)µm; ascus apex papillate, tropical...............*Hymenoscyphus sclerogenus*
(See also *Helotium camerunense*, *H. cantareirense*)

25. Ascospores without "nuclear staining area"..........26.

26. Ascospores regularly septate (more than 50% in any mount)..27.

27. Ascospores 1-septate, (17-)18-22(-24)x4-5(-6) µm; apothecia without hairs at the base of the stipe.............*Hymenoscyphus musicola*

27. Ascospores 3-septate, (20-)24-30(-35)x4-5(-6) µm; apothecia with abundant hairs at the base of the stipe..................*H. lasiopodius*

26. Ascospores aseptate.........................28.

28. Ascospores with a basal cilium (16-)18-22 (-26)x2-3µm.......................*H. scutula*

28. Ascospores without a basal cilium.........29.

29. Ascospores hooked apically..........30.

30. Ascospores strongly and obviously hooked, (16-)18-23(-30)x2-3(-4.5) µm, tapering gradually to the base. ....*H. serotinus*
(Also see *Helotium calyculus*)

30. Ascospores if hooked, only slightly and a few per mount, (14-)16-23 (-26)x4-5µm, abruptly pointed at the basal end.................................*Hymenoscyphus caudatus*

29. Ascospores not hooked apically.......31.

31. Ascospores (11-)12-15(-16)x(2.5-)3-4µm with internal, oily resinous contents..................*H. cereus*

31. Ascospores (14-)16-23(-26)x4-5(-6) µm without internal, oily resinous contents...............*H. caudatus*
(See also *Helotium calyculus*)

1. Asci operculate.................(See *Helotium buccina*, *H. rhytidodes*)

1. *Helotium aeruginosum* (Oed. per Purton) Gray, Nat. Arr. Brit. Pl. p. 661. 1821.

NOTES. As Dixon (1975) pointed out, this is a species referred to *Chlorociboria*, but also has been placed in *Chlorosplenium*. There has been considerable confusion concerning the identification of this species and its closest relative, *C. aeruginascens*; for separating features and neotropical distribution, see Dixon (1975). The species has been reported from the neotropics by several authors under *Helotium*, such as

Montagne (1853), Berkeley (1896), etc. I agree with the species placement in *Chlorociboria* and will not treat it further.

2. *Helotium albo-atrum* P. Hennings, Hedwigia 41: 24. 1902.
FIG. 1.

Stroma — Substratal, variable, visible on the host as single black lines extending irregularly along the surface of the host leaf or imbedded in the host; the black lines composed of rind cells with differentially pigmented walls, epidermoid to irregular in face view, also visible in section at the base of the stipe of the apothecium; not known in culture.

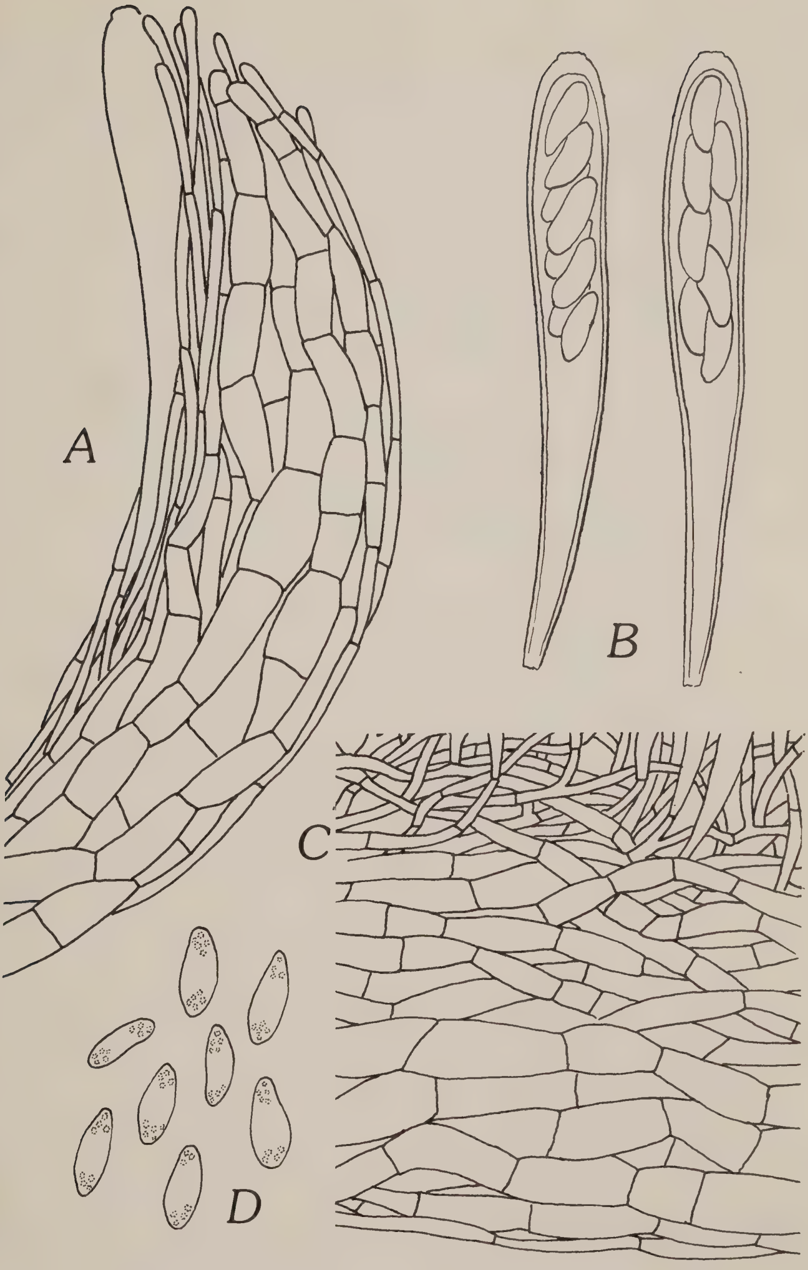
Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, gregarious, arising in association with black lines on the host, stipitate, to ca 1.0mm high, generally disc diam less than height of fruitbody, when fresh disc flat, drying flat, rehydrating flat. Hymenium when fresh white, drying black, rehydrating lighter and dark brown to almost black; margin when fresh, dry, or rehydrated concolorous with the hymenium; receptacle when fresh white, drying black, rehydrating dark; stipe cylindrical, ca 0.5mm long, ca 0.2 mm wide, broader above and tapering below to the base, black when fresh, dry, or rehydrated.

Apothecial anatomy — Asci 8-spored, ca 100-120x9-11µm, probably produced from croziers, long-cylindric to broadly clavate, gradually tapering toward the base and there becoming expanded to form a small foot, wall ca 1µm thick, enlarged or not at the rounded to truncate apex and there ca 1-2µm thick; pore J+, the walls outlined blue in Melzer's Reagent. Ascospores (12-)13-15(-16)x(4-)5-6(-7)µm, generally obliquely uniseriate or irregularly biseriate, hyaline, smooth, aseptate, ellipsoid to ovoid, ends rounded or rarely pointed below, in outline more or less equilateral, anterior end slightly broader; guttule details difficult to interpret owing to condition of material, but with 2 large polar guttules or guttulate areas ca 3µm wide visible in most spores. Paraphyses not well preserved, details obscured, reported by Hennings and Rick to be filiform, expanded at the apex and there 3-3.5µm wide, internally hyaline to yellowish. Subhymenium details uninterpretable owing to poor preservation of apothecium. Medullary excipulum poorly developed, non-refractive, pigmented light yellow to yellow-brown, composed predominantly of parallel hyphae originating in the stipe, but becoming slightly interwoven in the narrow flanks and just below the base of the asci, the individual hyphae light yellow-brown to brown, 3-7µm wide, the walls thin to thick, non-refractive, generally light yellow-brown to dark brown, smooth or roughened. Ectal excipulum poorly preserved, differentiation into inner ectal and outer ectal excipula doubtful, the entire area non-refractive, light brown to intensely dark brown, ca 15-20µm broad toward the margin and to ca 40µm broad towards the stipe, consisting predominantly of textura prismatica, with the individual

FIG. 1. *Lanzia albo-atra*, Möller 657, freehand drawings, x 1,000. A. Median longitudinal section of apothecium through margin. B. Two asci each containing 8 ascospores. C. Median longitudinal section of apothecium at approximately midpoint between margin and stipe. D. 8 ascospores drawn after discharge from the ascus.


A
B
C
D

hyphae generally collapsing, extending at a low angle to the surface of the apothecium, the individual cells toward the margin 8-22x4-8(-10)µm and 15-28x9-12(-14)µm toward the stipe, the walls thin to slightly thick, light to dark brown, smooth or roughened. Outer covering layer present, 1-2 layers of hyphae and 2-5µm wide, the individual hyphae extending parallel to the surface of the apothecium, overlapping, frequently terminating before the margin and the apically free cells unmodified, the individual cells light brown, dark brown to intensely pigmented, the walls non-refractive, thin to thick, pigmented brown, frequently roughened. Hairs absent. Margin details difficult to interpret owing to condition of apothecium, apparently constructed similarly to the flank below, the individual cells smaller, entire layer intensely pigmented. Stipe of rather uniform construction, to the outside the outermost 2-3 layers intensely pigmented and roughened, to the inside the pigmentation present, but less intense, individual hyphae 4-6µm wide, with walls thin to rarely slightly thickened and generally roughened; rind cells visible at the base of the stipe. Hairs absent.

Habitat: On fallen leaves of unidentified dicot plant.

Etymology of the specific epithet: refers to the white receptacle and black stipe.

Holotype: Helotium albo-atrum - Brazil, near Blumenau, Sta. Catharina, unidentified leaves, 15 Jul 1892, A. Möller 657 (ex S).

Specimens examined: known only from the type collection.

NOTES. Helotium albo-atrum was described as occurring on leaves from south Brazil by Hennings (1902) and was based on a Möller collection 657. Dennis, at least twice (Dennis, 1954 & 1960) compared this species with other species of *Hymenoscyphus* from the neotropics, but indicated (Dennis, 1954) that the type was presumed lost at Berlin. He did not mention the species in his last treatment of the genus (Dennis, 1964). I have examined a portion of Möller 657 deposited at S from the Sydow herbarium and conclude that it is a part of the type collection as the data agrees with the protologue.

I have observed a black line stroma on the host leaf in association with apothecia of this species and have observed rind cells at the base of the stipe and conclude that the species should be referred to the Sclerotiniaceae. With the production of a substratal stroma, and presence of an ectal excipulum composed of textura prismatica lacking a gelatinous matrix, the species could be referred to either *Lanzia* or to *Lambertella*. Since there is no pigmentation in the ascospores, the species is referred to *Lanzia*. I know of no earlier name for the species and thus make the formal transfer to *Lanzia* as follows:

Lanzia albo-atra (Hennings) Dumont, comb. nov.

Basionym: Helotium albo-atrum P. Hennings, Hedwigia 41: 24. 1902.

Lanzia albo-atra appears to be most closely related to *Lanzia luteovirescens*. In *L. luteovirescens* the ascospores are 12-16.5x5-7µm (White, 1942) and have large guttules which fill most of the spore, while in the type of *L. albo-atra* the ascospores have small polar guttulate areas. In *L. luteovirescens* the apothecia are yellowish with a green cast, while in *L.*

albo-atra the receptacle when fresh is white and the stipe black, and when dry the entire fruitbody is black. The sterile tissue of *L. albo-atra* is pigmented yellow-brown to dark brown, while in *L. luteovirescens* the sterile tissue is hyaline or very faintly yellowish and lacks the distinctive coloration of *L. albo-atra*.

3. *Helotium ambiguum* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. *Helotium ambiguum* was described by Rick from south Brazil as occurring on wood, but he did not cite any collection in the original description. Dennis (1954, 1960a, 1970) did not treat the species. I have been unable to locate any material on this species at K, S, NY, CUP, BPI, M, B, and the Rick Herbarium (PACA) and must assume that the type collection no longer exists.

From the brief four and one half line description, it is difficult to tell much about the fungus. The ascospores were said to be 7x3µm, and the substrate wood. There are few named neotropical Leotiaceae or Sclerotiniaceae with spore measurements that short occurring on wood. Two such species are *Hymenoscyphus leucopse* (Berk. & Curt.) Dennis and *Helotium microspermum* with ascospores 3.5-4x1.5-2µm. Until type material is found for this species, I am unable to treat this species further.

4. *Helotium angelense* Starbäck, Ark. Bot. 2(5): 4. 1904.

NOTES. *Helotium angelense* was described by Starbäck from south Brazil on leaves. I have been unable to locate authentic material of this species and am, therefore, uncertain of its relationships. According to the original description, the apothecia are yellow, black at the base, which is suggestive of the Sclerotiniaceae, and has ascospores 12-15x3-4µm. Should material of this species be located, it should be compared with several species such as *Hymenoscyphus caudatus*, *Lanzia albo-atra*, *Helotium titubans*, *Hymenoscyphus cereus* and *Helotium crocatum*. Until authentic material is located, I cannot consider the species further.

5. *Helotium atrosubiculatum* Seaver & Waterston, Mycologia 32: 397. 1940.

NOTES. *Helotium atrosubiculatum* Seaver & Waterston was described on leaves of *Archontophoenix alexandrae* Wenden & Drude from Bermuda. Dumont (1974) placed the species into taxonomic synonymy with *Lambertella microspora* (Seaver) Dumont; and for a full description and illustrations, see Dumont (1971), under the name *Lambertella pallidispora* Dumont. I continue to accept this placement of the species into synonymy with *L. microspora* and will not treat the species further here.

6. *Helotium atroviride* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium atroviride* was described on leaves by Hennings from two Möller collections, 31d and 409, from Brazil.

I only have been able to locate one collection, 409 and, thus designate this as the lectotype specimen for the species. The collection is rather poorly preserved and I here place it into tentative synonymy with "*Helotium crocatum*." See *H. crocatum* for full discussion. The type collection was filed under the epithet "*atro-virescens*."

Lectotype: Helotium atroviride - Brazil, Blumenau, Sta. Catharina, on unidentified leaves, Jan 1891, A. Möller 409 (ex S).

7. *Helotium aurantio-rubrum* Bresadola, Hedwigia 35: 295. 1896.

NOTES. Helotium aurantio-rubrum was described by Bresadola as occurring on wood from south Brazil and was based on a Möller collection 29b. As Dennis (1954) has pointed out, the holotype cannot be located and is presumed to be lost. From the original description, it is possible that the species is *Lanzia rufocornea*. Until the type is located or until a new one is designated, I can only place the species into tentative synonymy with *H. rufo-corneum*.

8. *Helotium bambusae* von Höhnel, Akad. Wiss. Wien, Math-Naturwiss. Kl., Denkschr. 83: 30. 1907.

NOTES. Helotium bambusae was described from Brazil as occurring on culms of bamboo. I have examined the presumed holotype deposited at FH, and it is very poorly preserved and appears to have been preserved in a liquid such as alcohol. Most of the anatomical details are either obscured or contorted, and it is for this reason that I have been unable to present a full description. Because so much of the apothecium studied appears badly preserved, I will only present only relevant information which will help in placing the species properly and in recognizing it in the future.

I have noted that the substrate is obviously blackened, and it appears that the fungus produces a substratal stroma, since rind cells were observed on the host and at the base of the stipe of the apothecium. The details of the hymenial elements are almost entirely obscured. The asci in the original description were said to be ca 120x6-6.5µm, and J+. I have seen several ascospores which appear to be normal, and they are 8-10x2-3µm, have two large polar guttules, are equilateral to slightly inequilateral and not flattened, have ends rounded to slightly pointed, and are aseptate and hyaline. There are paraphyses present which appear to be pigmented light brown, while others are probably hyaline, and they were said to be 3 µm wide in the original description.

The sterile tissue of the apothecium is extremely difficult to interpret. The entire internal tissue is pigmented light to dark brown, the individual hyphae are hyaline to intensely pigmented, and the walls are frequently roughened. The subhymenium and margin are more intensely pigmented than the remainder of the fruitbody. The ectal excipulum is highly refractive, especially in the stipe, and the narrow hyphae (ca 2-3µm wide) appear to be embedded in a gelatinous matrix. The subhymenium appears to be made up of narrow, vertically oriented, pigmented hyphae.

Because a substratal stroma is produced the species should be referred to the Sclerotiniaceae, and if my interpretation of the ectal excipulum is correct and a gelatinous matrix is present, then it should be referred to *Poculum*. *Helotium bambusae* could be confused with a foliicolous species of *Poculum*, *Helotium titubans*, which has ascospores (9-)11-13x3-4µm. In *H. bambusae* the ectal excipulum is composed of long-narrow cells and in *H. titubans* the cells are brick-shaped; the ascospores in *H. bambusae* are biguttulate, while in *H. titubans* they are multiguttulate. I know now of no other species of *Poculum* with which this species could be confused. I thus propose here the formal transfer to *Poculum* as follows:

Poculum bambusae (von Höhnel) Dumont, comb. nov.

Basionym: Helotium bambusae von Höhnel, Akad. Wiss. Wien, Math-Naturwiss. Kl., Denkschr. 83: 30. 1907.

Presumed holotype: Helotium bambusae - Brazil, São Paulo, Bertiago, near Santos, on culm of bamboo, 1901, F. von Höhnel, s.n. (ex FH, herb von Höhnel no. 5395).

9. *Helotium belisense* Kanouse, Mycologia 33: 465. 1941.

≡ *Lambertella belisense* (Kanouse) Dumont, Mycologia 66: 342. 1974.
≡ *Rutstroemia belisense* (Kanouse) Dennis, Persoonia 3: 36. 1964.

NOTES. *Helotium belisense* was described from British Honduras (now called Belize) as occurring on leaves of *Ilex* and was based on a Main 3606 collection. Dumont (1974) showed the species to be a *Lambertella* and an older name for *Lambertella boliviana* Dennis, a decision with which I still agree. For a full description, illustrations, and discussion, see Dumont (1971, 1974).

10. *Helotium blumenaviense* P. Hennings, Hedwigia 41: 24. 1902.

NOTES. *Helotium blumenaviense* was described from a downed palm frond and was based on Möller 347. I have examined the type deposited at S and conclude that the species is an *Orbilia*. I am not well enough acquainted with the neotropical species of *Orbilia* to propose a transfer to that genus, and will not treat it further here.

The ectal excipulum is composed of large globose to irregular cells with frequently thickened walls, the individual cells and asci are respectively ca 10-30µm and 24-30x3-4µm. The paraphyses and other details of the microanatomy cannot be interpreted owing to the poor preservation of the apothecium.

Holotype: Helotium blumenaviense - Brazil, Catharina, on palm, 17 Jan 1892, A. Möller 347 (ex S).

11. *Helotium buccina* (Persoon ex Persoon) Fries, Summa veg. Scand, p. 355. 1849.

NOTES. Helotium baccina was reported from Chile by Montagne (1853). I have examined the specimen from PC upon which this record was based and find it to be an operculate Discomycete doubtless referrable to the Sarcoscyphaceae. Thus, to my knowledge, *H. buccina* is still unknown from the neotropics.

Specimen examined: Chile, near Valdivia, on dead wood, M. Gay, sn, s.f. (ex PC).

12. *Helotium calyculus* (Sow. ex Fries) Fries, Summa veg. Scand. p. 355. 1849.

NOTES. Helotium calyculus was reported from Venezuela by Dennis (1960, 1970). As Dumont & Carpenter (1981) have pointed out, the type of *Peziza calyculus* appears to be the same as *Peziza firma* Persoon, and it is probable that the taxon previously referred to as *Helotium calyculus* will need a new name.

The Dennis report from Venezuela is based upon one of his own collections, Dennis 2452. I have examined the collection and have a somewhat different interpretation than Dennis. Dumont & Carpenter (1981) have discussed their neotropical collections of *Hymenoscyphus caudatus* and *H. serotinus* and have pointed out that both are very variable species and are probably very closely related. They further pointed out that broad-spored collections of *H. serotinus* approached those of *H. caudatus* and that narrow-spored collections of *H. caudatus* approached those of *H. serotinus*. They cited one collection which they felt was an intermediate between the two.

Dennis 2452 appears to fall into the *H. caudatus*-*H. serotinus* complex, but I cannot satisfactorily place it into either one or the other. The ascospores are 16-20x4-6μm, ellipsoid, frequently slightly hooked at the apex, taper to a small point at the base and cannot be distinguished from those of *H. caudatus*. However, the fruitbody of *H. caudatus* appears to be consistently tiny, less than 1mm high and wide, and generally light yellow to off white. The fruitbody of the Dennis collection appears to fall into the range of *H. serotinus*, which has apothecia up to 2mm diam and to 5mm high, varying in coloration from yellow to orange to dark brown. The apothecia of the Dennis collection are to 3mm wide, and ca 10mm high and dry brownish. Until I have more material similar to the Dennis collection, I must reserve judgement as to its final identification and placement, and conclude that it is an intermediate form.

13. *Helotium camerunense* P. Hennings, Bot. Jahrb. Syst. 22: 73. 1895.

NOTES. Helotium camerunense was described by Hennings from Africa from a Dusén collection. Dennis (1958) reported the species from Bolivia, based on three Singer collections, B620, B644, and B891/2; Rick (1931) described a variety *brasiliense* from Brazil.

I have examined the three Singer collections and conclude that they are *Hymenoscyphus sclerogenus* (Berkeley & Curtis)

Dennis as defined by Dumont & Carpenter (1981). I have attempted to locate the type of *Helotium camerunense* Hennings var. *brasiliense* Rick, but could not locate it at K, S. B, M, FH or BPI. I have found a collection of *Helotium camerunense* deposited at NY made by Rick and from the Bresadola herbarium. Since Rick did not actually designate a specific collection as the type, there remains some doubt as to whether or not this is the actual holotype of Rick's variety. It does agree with the protologue for the variety and I thus designate it as the neotype rather than as lectotype, since there is some doubt as to whether it is part of the holotype. This specimen is marked with the number "#27 = 71!" The collection agrees in all regards with *Helotium rufo-corneum*, and I thus place Rick's variety into synonymy with *H. rufo-corneum*, which has priority. For full description and illustrations of *Hymenoscyphus sclerogenus* see Dumont & Carpenter (1981) and for *Helotium rufo-corneum* see Dumont (1980).

I have been unable to locate the type specimen of *H. camerunense* at S, K, H, B, M, NY, FH, S, and from the brief original description cannot determine what the species actually is. From the description it could be *Hymenoscyphus lasiopodium*, *H. sclerogenus*, or *Lanzia rufocornea*. I am unprepared to designate a neotype specimen for the species and cannot treat it further here.

14. *Helotium cantareirense* (P. Hennings) Rick, Brotéria, Sér. Bot. 25: 116. 1931.

≡ *Lanzia cantareirensis* P. Hennings, Hedwigia 43: 208. 1904.

NOTES. *Lanzia cantareirensis* was originally described by Hennings from south Brazil as occurring on palm fibers. I have examined a portion of the holotype collection deposited at S and conclude that it falls within the concept of *Hymenoscyphus sclerogenus* as presented by Dumont & Carpenter (1981). I, thus, place *Helotium cantareirense* into synonymy with *Hymenoscyphus sclerogenus* and adopt the latter name as it has priority. For full descriptions and illustrations of *H. sclerogenus*, see Dumont & Carpenter (1981).

Holotype: Lanzia cantareirensis - Brazil, São Paulo, Serra da Cantareira, auf Palmenfasern, Mar 1903, Puttemans 869 (S).

15. *Helotium caracassense* Dennis, Kew Bull. 1954: 324. 1954.

NOTES. *Helotium caracassense* was described by Dennis (1954) from a single collection on leaves of an unidentified plant from Venezuela. After studying the type collection deposited at Kew, I conclude that it fits well into the concept of *Lambertella microspora* (Seaver) Dumont, which is a very common and variable fungus found throughout the tropics. For full description and illustrations, see Dumont (1971) under the name *L. pallidispora* Dumont.

Holotype: Helotium caracassense - Venezuela, Country Club, Río Chacaito, Caracas, on dead and decaying leaves, 18 Nov 1949, R. W. G. Dennis 370 (ex K).

16. *Helotium castaneum* P. Hennings, Hedwigia 36: 233. 1897.

≡ *Helotium subcastaneum* P. Hennings in Sacc. & Syd., Syll. Fung. 14: 764. 1899.

NOTES. *Helotium castaneum* was described from a Möller collection from Brazil on branches. Saccardo & Sydow (1899) showed the species to be a later homonym of *Helotium castaneum* Saccardo & Ellis in Saccardo (1882) and renamed the species *Helotium subcastaneum* Hennings in Saccardo & Sydow. I have been unable to locate the Hennings type in any of the herbaria surveyed. Neotropical species of the Leotiaceae or Sclerotiniaceae with small spores (those given in the original were said to be 4-5x2-3μm) are not common, and we conclude from the description that this species could be synonymous with *Helotium leucopse* or *H. microspermum*. We must, however, reserve final judgement until type or authentic material is located.

17. *Helotium caudatum* (Karsten) Velenovský, Monogr. Discom. Bohem. 1: 206. 1934.

≡ *Peziza caudata* Karsten, Fungi fenn. ex. 547. 1866.

NOTES. *Hymenoscyphus caudatus* (Karsten) Dennis was reported from the neotropics by Dumont & Carpenter (1981). For a full description, illustrations, and discussion of neotropical relatives, see that paper.

18. *Helotium cecropiae* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium cecropiae* was described from south Brazil on leaves. Dumont (1976) placed the species into taxonomic synonymy with *Helotium lentum* Berkeley & Broome (= *Moellerodiscus lentus*). For complete description, illustrations and discussions, see Dumont (1976). I agree with the placement of the species in *Moellerodiscus* and will not treat it further here. Dennis (1962) placed the species in *Ciboriopsis* as *C. lentus* (Berkeley & Broome) Dennis.

19. *Helotium cereum* (Rick) Dennis, Kew Bull. 14: 123. 1960. FIG. 2.

≡ *Ciboria cerea* Rick, Brotéria, Sér. Bot. 25: 119. 1931.
≡ *Hymenoscyphus cereus* (Rick) Dennis, Persoonia 3:76. 1964.

Apothecial morphology — Apothecia gregarious, stipitate, 1-2mm in diam, "6"mm high, when fresh waxy and pallid throughout, drying nearly black, rehydrating slightly lighter.

Apothecial anatomy — Asci 8-spored, 60-80x6-8μm, probably produced from tiny croziers, long cylindric-clavate, gradually tapering to the base and there becoming expanded to form a tiny foot, wall ca 1μm thick, enlarged at the papillate to subtruncate apex and there 2-3μm thick, pore weakly J+. Ascospores (11-)12-15(-16)x(2.5-)3-4μm, obliquely uniseriate to irregularly biseriate, hyaline, smooth, aseptate, ellipsoid to subfusoid, anterior ends rounded, posterior ends pointed, in outline inequilateral, flattened on one surface, anterior end broader, posterior end frequently becoming slightly drawn out; guttules probably present, internally

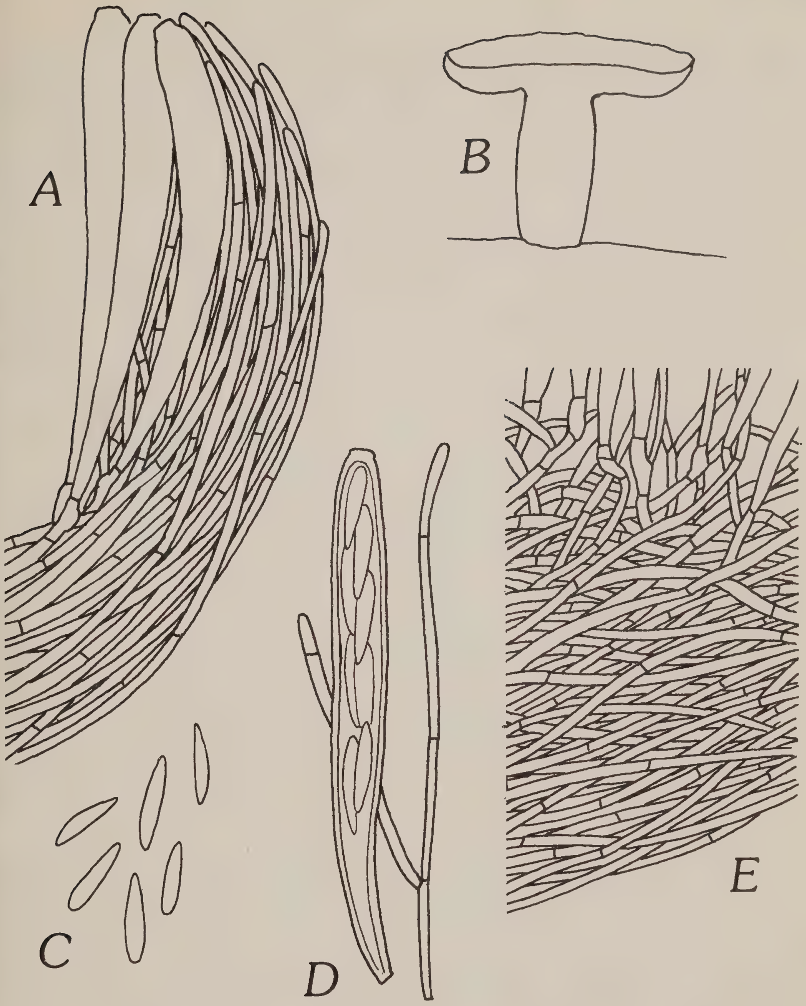


FIG. 2. *Hymenoscyphus cereus*, PACA 12645, freehand drawings. A. Median longitudinal section of apothecium through margin. B. Habit sketch of entire fruitbody on substrate. C. 6 ascospores drawn after discharge from the ascus. D. An ascus and paraphysis. E. Median longitudinal section of apothecium at approximately midpoint between margin and stipe. A, C, D, E x 1,000; B x ca 50.

with oily resinous material either filling the entire ascospore or becoming broken up and centralized in bipolar areas. Paraphyses equal to the asci, branched toward the base and septate, filiform becoming 2-3µm broad at the apex. Subhymenium not differentiated from the medullary excipulum.

Medullary excipulum not well developed, nearly absent in the flanks and undifferentiated from the outer ectal excipulum, entire region hyaline, individual hyphae 1-2μm wide. Ectal excipulum undifferentiated into inner and outer regions, very simple, grading into the medullary excipulum, details somewhat obscured, composed of a small-celled textura porrecta, the individual hyphae ca 2-3(-4)μm wide. Margin constructed similarly to the flanks below, slightly broader above than below, entire region hyaline. Stipe constructed as the lower portion of the receptacle, to the outside the hyphae occasionally pigmented light brown.

Habitat: On veins of leaves of Tiliaceae, perhaps *Luhea*.

Etymology of the specific epithet: refers to the waxy appearance of the apothecia in fresh condition.

Holotype (presumed): Ciboria cerea - Brazil, São Leopoldo, in foliis Tiliaceae "(Inhea)", Braun, 1929 s.n. (PACA 12645).

Illustrations: Dennis, Kew Bull. 14: 124, fig. 12. 1960.

NOTES. *Ciboria cerea* was originally described by Rick (1931) from Brazil as occurring on leaves. It was transferred first by Dennis (1960a) to *Helotium*, then to *Hymenoscyphus* (Dennis, 1964), a decision with which I concur. The species is most easily distinguished from all other species of neotropical *Hymenoscyphi* by the rather simple, homogeneous construction of the sterile tissue of the apothecium and by the resinous-oily material in the spores. The hyphae comprising the sterile tissue are 1-2(-3)μm wide and basically undifferentiated between the subhymenium, medullary excipulum and ectal excipulum. Since all of the tissue is a textura porrecta and lacks any globose or angular cells, it appears to be most closely related to the species in the *H. caudatus* group rather than the *H. epiphyllus* group, which has globose cells in the stipe and frequently in the lower portion of the flanks.

20. *Helotium chromo-flavum* Rick, Brotéria, Sér. Bot. 25: 114. 1931.

NOTES. *Helotium chromo-flavum* was described on leaves from south Brazil. Dennis (1960a) redescribed and illustrated the species, but declined to express an opinion on the taxonomic position of the species owing to the lack of adequate material for study. Dumont (1974) re-examined the type and found the species to be an older name for *Lambertella phaeoparaphysata* Dumont, and transferred the species to *Lambertella*. I have concluded from the present studies that still another name, *Helotium spadiceo-atrum*, is even older, and the actual transfer to *Lambertella* is made below. For a full description, illustrations and discussion on relationships, see Dumont (1971), as *L. phaeoparaphysata*.

21. *Helotium citrinum* (Hedwig ex Purton) Fries, Summa veg. Scand. p. 355. 1849.

NOTES. *Helotium citrinum* has been reported several times from throughout the neotropics, such as Montagne (1853) from Chile, Patouillard & Lagerheim (1893) from Ecuador, Duss (1903) from Guadeloupe, etc. It is very common in temperate regions and until recently it was generally referred to the genus *Calycella*, but according to Korf & Carpenter (1974) it must now be called *Bisporella*. Carpenter & Dumont (1978) have presented a review of the common neotropical species of *Bisporella*, and the species will not be treated further here.

22. *Helotium conocarpi* Seaver & Waterston, Mycologia 34: 517. 1942.

NOTES. *Helotium conocarpi* was originally described on leaves from Bermuda by Seaver & Waterston and transferred to *Moellerodiscus* by Dumont (1976). For a complete description and illustrations, see Dumont (1976). I agree with the placement of the species in *Moellerodiscus* and will not treat it further here.

23. *Helotium crocatum* (Montagne) Le Gal, Prod. Flore Mycol. Madagascar 4: 347. 1953. FIGS. 3, 4.

≡ *Peziza crocata* Montagne, Ann. Sci. Nat. Bot., Sér. 2, 13: 207. 1840.
≡ *Hymenoscyphus crocatus* (Montagne) Kuntze, Revis. gen. Pl. 3(3): 485. 1898.
≡ *Poculum crocatum* (Montagne) Dumont in Dumont & Pal, Mycologia 70: 85. 1978.

Stroma — Substratal, on the host petiole easily visible as blackened areas, forming a discontinuous rind with epidermoid to irregular cells as seen in face view; in section rind cells visible at base of stipe of apothecium; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, scattered along the petiole of host leaf and arising in association with and from blackened areas, stipitate, 0.5-1.5mm in diam, to ca 1.0 high, disc when fresh, dry, and rehydrated flat; hymenium, receptacle, margin, and upper portion of stipe when fresh yellow, drying and rehydrating pallid to translucent; base of stipe blackened.

Apothecial anatomy — Asci 8-spored, ca 100-125x8-10μm, presence or absence of croziers not determined, long-cylindric, gradually tapering toward the base and there details obscured, wall 1-2μm thick, enlarged at the rounded to subtruncate apex and there 2-3(-4)μm thick; pore reaction in Melzer's Reagent not determined. Ascospores (20-)21-23(-25)x2.5-3.5 (-4)μm, generally biseriate throughout or less commonly irregularly and obliquely uniseriate, hyaline, smooth, aseptate, ellipsoid to subfusoid, in outline inequilateral, flattened on one surface or curved and the anterior end broader and constricted in lower portion of spore, guttular condition uncertain, possibly with two polar guttulate areas composed of one large guttule or one broken into smaller ones; anterior end of spore frequently somewhat "flared." Paraphyses present, but details uninterpretable. Subhymenium apparently undifferentiated from medullary excipulum. Medullary excipulum poorly developed and differentiated from subhymenium, composed of narrow (to ca 2μm wide), more or less parallel hyphae originating in the stipe and nearly absent in the flanks. Ectal excipulum

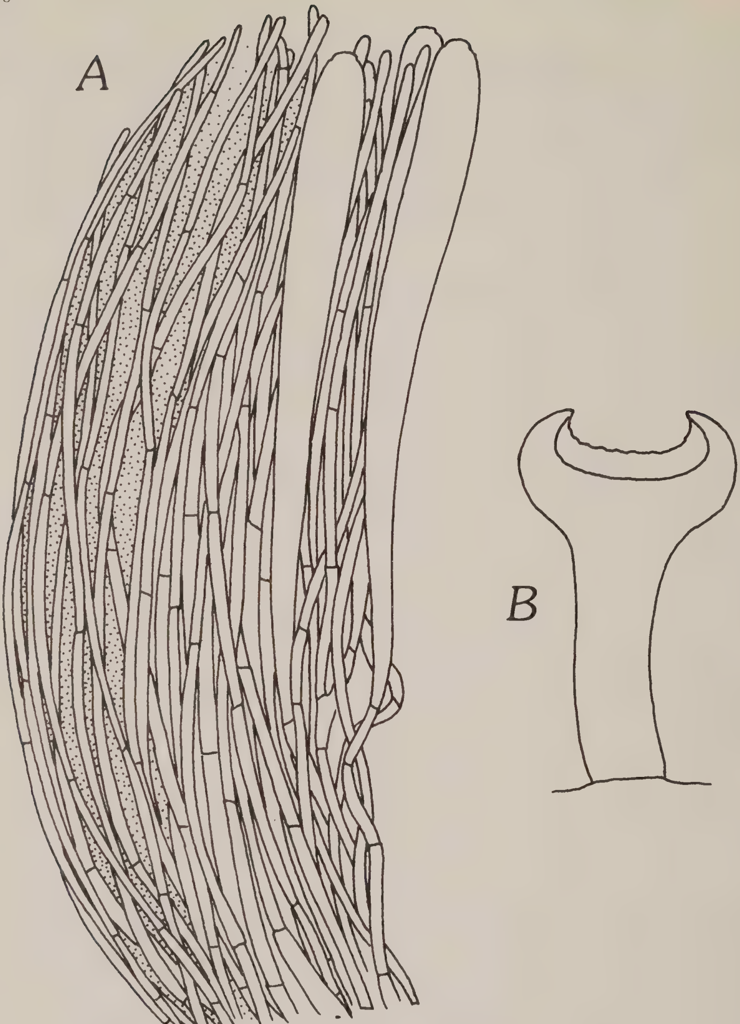


FIG. 3. *Poculum crocatum*, Leprieur 439 ex NY, freehand drawings. A. Median longitudinal section of apothecium through margin, x 1,000. B. Habit sketch of entire fruitbody on substrate, x ca 50.

highly refractive, doubtfully distinguished into inner and outer ectal excipulum, to ca 35µm broad toward the margin and slightly broader toward the stipe, composed of hyphae extending parallel or at a low angle to the surface of the apothecium and imbedded in a gelatinous matrix, the individual hyphae (3-)4-6(-8)µm wide; outer covering layer doubtfully present, but occasionally with the outermost cells of the outer ectal excipulum be-

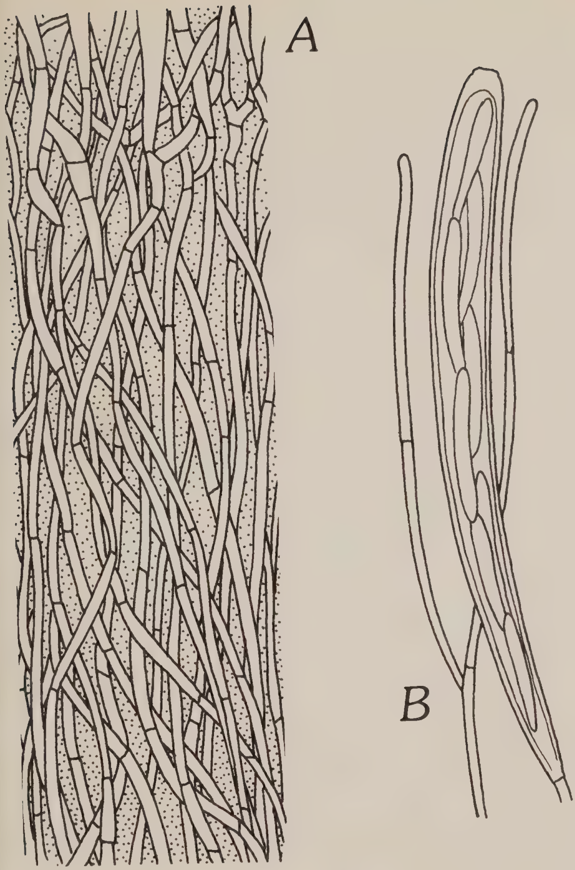


FIG. 4. *Poculum crocatum*, Leprieur 439, freehand drawings, x 1,000. A. Median longitudinal section of apothecium from base of asci through subhymenium, medullary excipulum, and ectal excipulum. B. An ascus with 8 ascospores and a paraphysis. C. 6 ascospores drawn after discharge from ascus.

coming lightly pigmented and slightly roughened. Margin constructed similarly to the ectal excipulum, but the hyphae narrower and the gel more prominent and more refractive than the tissue below, apical cells unmodified. Stipe with the outermost layer highly refractive and similar to the flank and to the inside the gel absent and with the hyphae 2-4μm wide; hairs not observed.

Habitat: On petiole of undetermined leaves.

Etymology of the specific epithet: refers to the yellow color of the apothecium in fresh condition.

Holotype: French Guiana, Sinnamarie, petioles of fallen leaves, Jan, Leprieur 439 (Montagne, Plantes cellulaires exotiques nouvelles Sér. II, no. 19, leg Leprieur. 439).

Illustration: Dennis, Kew Bull. 1954: 327, fig. 36. 1954.

NOTES. *Peziza crocata* was originally described on petioles of leaves from Surinam. Dennis (1954) reported the species from Jamaica, based on one of his own collections, (J72) which I have not seen, and later transferred the species to *Hymenoscyphus*. I have examined a portion of the original collection, Leprieur 439, deposited NY, and find it to be somewhat poorly preserved with many of the apothecia covered by an unidentified mold. Thus many of the microscopic features could not be studied adequately, and many of the observations are highly tentative and subject to change when additional material of the species is obtained and analyzed. Dennis (1954) in his study of the species reported the ascospores of the species to be 21-27x3µm, while I have found them to be (19-)21-23(-25)x2.5-3.5(-4)µm.

As pointed out by Dumont and Pal (1978), a stroma is produced; the species is, therefore, referred to the Sclerotiniaceae, rather than the Helotiaceae (= Leotiaceae) as has been done generally. I agree that the species should be placed in *Poculum*.

Helotium atroviride Hennings was described on leaves from south Brazil. I have studied the lectotype collection (designated above) and conclude that it could possibly be a synonym of *Poculum crocatum*. However, as with the type of *P. crocatum*, I find the apothecia of *H. atroviride* to be somewhat poorly preserved and possibly slightly immature. In the original description, the apothecia were said to be "atroviridulo," but in the collection studied the apothecia were of a small, yellow, stipitate Discomycete. In the original description the ascospores were reported to be 15-21x3µm, but I have found only a very few approaching 20µm long. Also the ectal excipulum of *Poculum crocatum* is more obviously gelatinized than in the lectotype of *H. atroviride*, and the hyphae of *H. atroviride* are narrower than those of *P. crocatum*. Until more material of either is available, I am unable to understand the variation, and can only place *H. atroviride* into tentative synonymy with *P. crocatum*.

24. *Helotium crocinum* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1869 ('1868').

NOTES. *Helotium crocinum* was described on twigs from Cuba and was based on a Wright collection, 374. I have examined a portion deposited in the Curtis collection at FH, and it is different from the one deposited at K. D. H. Pfister has ananotated the FH collection as a species of *Phillipsia*, with which I agree. The portion deposited at K was identified by Dennis (1954) as *Calycella citrina*, a decision with which I agree. The two portions of the Wright collection represent isotypes, and according to the International Code of Botanical Nomenclature, one must be selected as the lectotype. I designate the K portion of Wright 374 as the lectotype portion of *Helotium crocinum* Berkeley & Curtis as it agrees with the protologue, whereas the FH portion clearly represents another species not described in the protologue.

Dennis (1954) cited the basionym of this species as "*Peziza crocina* Berk. & Curt., J. Linn. Soc. Bot. 10: 369 (1868)." In the original description the species was actually cited "*H.* [*Helotium*] (*Calycella*) *crocinum* B. & C." For a full discussion of some neotropical species of *Calycella*, now referred to as *Bisporella*, see Carpenter & Dumont (1978).

Lectotype: Cuba, on twigs, C. Wright 374 (ex K, with the name "*Pez. crocina* B. & C." written on the packet).

25. *Helotium cupreum* Bresadola, Hedwigia 35: 295. 1896.

NOTES. *Helotium cupreum* was described on wood from Blumenau, Brazil, and was based on a Möller collection, 29c. Dennis (1954) indicated that he had not seen the type, and I have been unable to locate the type at the herbaria surveyed. I have, however, located another Möller collection, 54d, also collected on wood from Blumenau and identified by Bresadola as *Helotium cupreum*. The collection agrees with the protologue of *H. cupreum* and, I thus, designate Möller 54d, deposited at S, as the neotype collection. I have further compared the type specimen of *Helotium leucopse* with that collection and find them to represent the same species. Since *H. leucopse* has priority, I place *H. cupreum* into synonymy with it. For further discussion see *H. leucopse* below.

Illustration: Dennis, Kew Bull. 1954: 326, fig. 35 right. 1954.

Neotype: *Helotium cupreum* - Brazil, Blumenau, on wood, A. Möller 54d (ex S, slides deposited NY with Dumont number 3036).

Helotium cupreum was also reported from Brazil by Rick (1931), and there are five collections in his herbarium at PACA. One collection, Rick 13212, is marked "Typus," which it cannot be, since it was collected in 1905, and the species was described in 1896. Three collections 13217, 13218, 13226 are *Helotium leucopse*, while 13212 and 13219 represent a very distinct taxon, *Moellerodiscus musae* (Dennis) Dumont.

Additional specimens studied: Brazil: São Leopoldo, on wood, 1902, Rick (ex PACA 13212); São Leopoldo, on wood, 1904, Rick (ex PACA 13217); São Leopoldo, on wood, 1930, Rick (ex PACA 13218); São Leopoldo, on decorticated wood, Oct 1939, Rick (ex PACA 13219); São Leopoldo, decorticated wood, 1905, Rick (ex PACA 13226).

26. *Helotium discedens* Karsten, Hedwigia 28: 191. 1889.

NOTES. *Helotium discedens* was described on wood from Minas Geraes, Brazil, and was transferred to *Calycella* by Dennis (1954). Carpenter (1975) partially redescribed the species and transferred it to *Bisporella* as *B. discedens* (Karsten) Carpenter. He further gave an expanded synonymy and reported the species from Brazil, Guadeloupe, Haiti, Dominica, Philippines, Colombia, Venezuela, etc. Carpenter & Dumont (1978) have further discussed the species and its relatives in tropical America and have indicated that it is one of the most common species of Inoperculate Discomycetes encountered in the neotropics.

I have recently examined European specimens identified as *Bisporella sulfurina* deposited at PC and find them to be the same species which we were calling *B. discedens* from tropical America. I have been unable to locate the type of *B. sulfurina* and cannot place *B. discedens* into synonymy with it until a type has been located or a neotype designated. I must reserve final judgement until later, and here only suggest possible synonymy.

Illustrations: Carpenter, Mycotaxon 2: 125, fig. 1. 1975.

Specimens studied of B. discedens: see Carpenter & Dumont (1978).

Additional specimens studied and identified as Bisporella (Calycella) sulfurina: France: Dept. Saone & Loire, decorticated dead branches, date not given, J. Guillemin (ex PC, det. L. Quélet); Dept. Seine & Maire, branches of *Ulmus*, date not given, Mlle Decary (ex PC, det. Boudier); Dept. Loire & Cher, wood, Oct 1932, A. Buisson (ex PC, det. L. Quélet); Dept. Var, branches of *Quercus coccifera*, Dec 1925, A. de Crozals (ex PC, det. Quélet).

27. *Helotium discula* Ferdinandsen & Winge, Bot. Tidsskr. 30: 211. 1910.

NOTES. *Helotium discula* was described from Venezuela on wood. Dennis (1954) has indicated that he could not locate the type and that the fungus could be a lichen or at least a member of the Lecanorales. I have not been able to locate the type or authentic material of this species and from the description agree with Dennis.

28. *Helotium disseminatum* P. Hennings, Hedwigia 41: 25. 1902.

NOTES. *Helotium disseminatum* was described from Brazil on palm leaves. I have examined a portion of the type deposited at S and find it to be no *Helotium* at all, rather a species of *Orbilia*. The ectal excipulum is composed of large, angular to globose cells, and the asci are ca 30x2-3μm and generally flattened at the apex. The paraphyses appear to be expanded at the apex and there to 4μm wide. I have been unable to make out the details of the ascospores, which in the original description were said to be 5-7x1-1.5μm. I choose not to make a transfer of the species to *Orbilia* until the other neotropical species of the genus are better understood.

Holotype: Helotium disseminatum - Brazil, Sta. Catharina, Blumenau, A. Möller, palm leaves, 1892 (ex S).

29. *Helotium epiphyllum* (Persoon ex Persoon) Fries, Summa veg. Scand. p. 356. 1849. FIGS. 5, 6.

≡ *Peziza epiphylla* Persoon, Ann. Bot. (Usteri) 11: 30. 1794.
≡ *Peziza epiphylla* Persoon ex Persoon, Mycol. Eur. 1: 295. 1822.

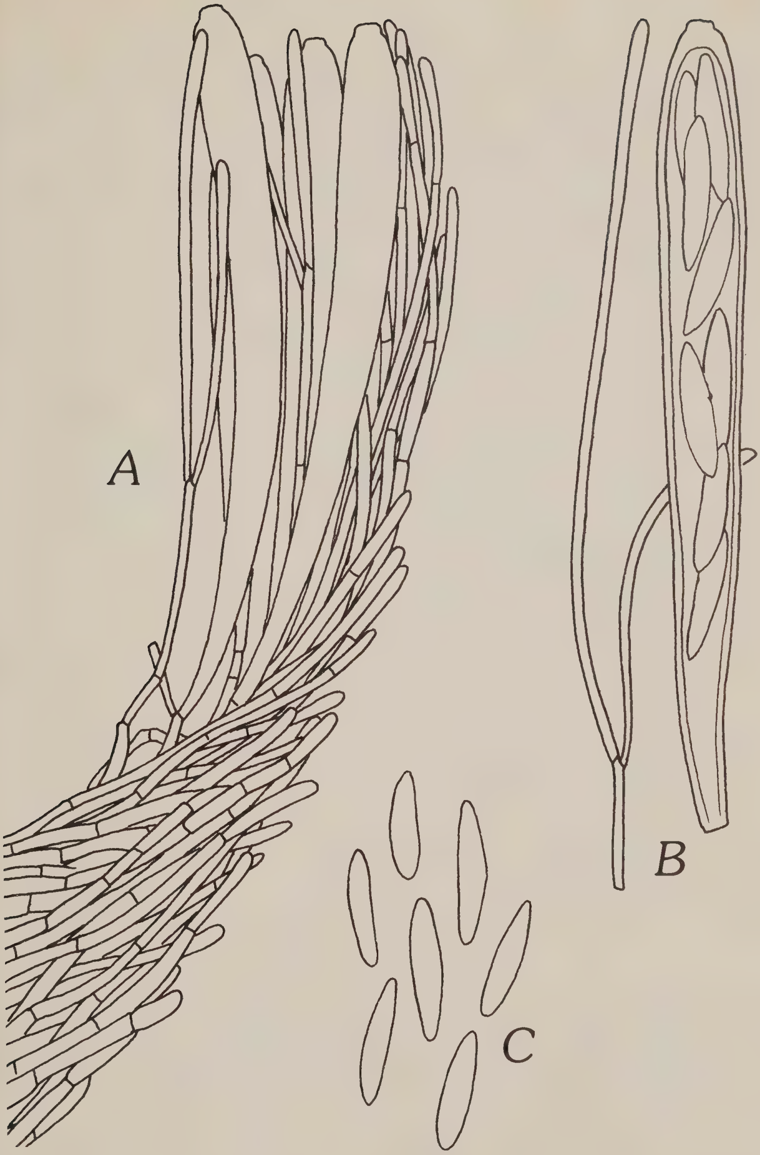


FIG. 5. *Hymenoscyphus epiphyllus*, CUP-ME 146, freehand drawings, x 1,000. A. Median longitudinal section of apothecium through margin. B. An ascus with 8 ascospores and a paraphysis. C. 7 ascospores drawn after discharge from ascus.

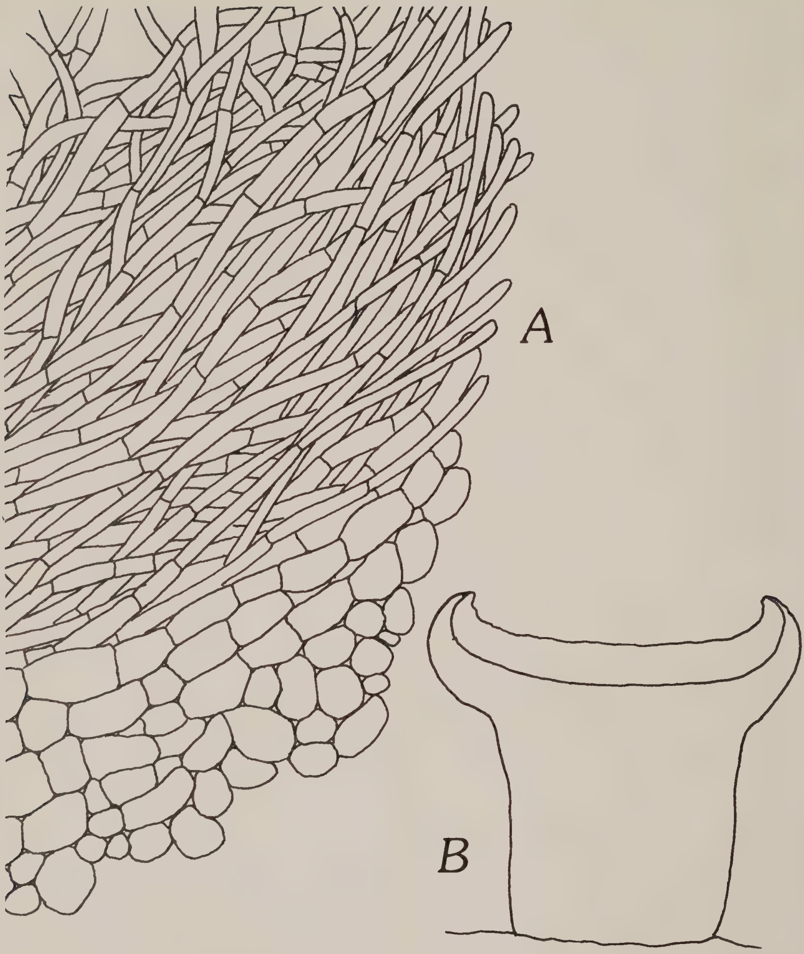


FIG. 6. *Hymenoscyphus epiphyllus*, CUP-ME 146, freehand drawings. A. Median longitudinal section of apothecium at a point in the flank just above the juncture of the receptacle and stipe, x 1,000. B. Habit sketch of entire fruitbody on substrate, x ca 50.

NOTES. *Helotium epiphyllum* is a common, subsessile, yellow to orange-yellow Inoperculate Discomycete found frequently throughout Europe and North America. I have attempted to locate the type of the species in the Persoon collection, but specimens identified as *Peziza epiphylla* contain no apothecial material, only sclerotia (which could be mistaken for subturbinate apothecia) of an undetermined fungus. I am thus following here the concepts of White (1943) and Dennis (1956), and I have not studied the species extensively and am uncertain of its morphological, anatomical variation and geographical distribution.

Helotium epiphyllum was reported from Guadeloupe by Duss (1903) and from Ecuador by Patouillard & Lagerheim (1895). I have been unable to locate the material upon which the Guadeloupe report was based, but have studied the Ecuadorian collection. The preservation of the material is such that exact identification is not possible, but I have observed in the ectal excipulum chains of globose cells which is suggestive of *Moellerodiscus*. The small ascospores, ca 4-5x1.5-2μm are reminiscent of *M. lentus*, a common neotropical species. For a complete discussion and illustration of *M. lentus*, see Dumont (1976).

I have studied two collections deposited in the Rick herbarium at PACA, 13207 and 13225, which were identified as *H. epiphyllum*, but neither represents this species. The ectal excipulum appears to be constructed similarly to *H. epiphyllum*, but the ascospores are too small, (7-)8-11(-13)x3-4μm. An additional collection (13220) identified as *H. epiphyllum* represents the same taxon. A fourth collection (13221) is somewhat poorly preserved, but may be the same taxon. The species is currently unknown to me, but is surely closely related to *H. epiphyllum*. Thus the collections upon which the previous reports of *H. epiphyllum* from the neotropics were based either cannot be located or represent still additional species. I have been unable to verify the occurrence of *H. epiphyllum* in the neotropics.

I have examined two collections (CUP-ME 144 & 146) from Mexico which may represent *H. epiphyllum*. These two collections are somewhat different from the limited concept of the species which I now have. My collections occur on pine needles and on leaves of *Quercus* sp. The apothecia have a longer stipe than expected for the species, but structurally they seem to represent *H. epiphyllum*. I present here a description of the species based on the two collections, in hopes that this may aid subsequent identification of the species in the neotropics.

Apothecial morphology — Apothecia variable, solitary, substipitate to subturbinate, to ca 2mm wide and ca 1.5mm high, colors not recorded in fresh condition, disc when dry slightly cupulate, rehydrating flat to slightly cupulate. Hymenium when dry flesh-colored to orange-yellow, rehydrating lighter and having a water-soaked appearance to pallid; margin concolorous with the hymenium; receptacle when dry off-white to gray-white, rehydrating lighter and lighter than the hymenium; stipe very broad in relation to diam of receptacle, concolorous with the receptacle when dry and rehydrated.

Apothecial anatomy — Asci 8-spored, 90-120x(9-)10-11(-12)μm, produced from croziers, long cylindric-clavate, gradually tapering towards the base and there not expanding to form a foot, wall ca 1μm thick, enlarged at the truncate apex and there 2-3μm thick; pore J+, the walls outlined faintly blue in Melzer's Reagent. Ascospores (16-)18-22(-24)x(3-)4-5μm, uniseriate throughout to less commonly biseriate above and uniseriate below, hyaline, smooth, aseptate, ellipsoid to subfusoid, ends rounded to slightly pointed, in outline inequilateral, flattened on one surface, both ends equal or anterior end slightly broader, guttules spherical to irregularly shaped, filling major portion of ascospore and generally separated by a narrow band of cytoplasm or with two large guttules and a broad band of cytoplasm in the central region of the spore. Paraphyses slightly exceeding the asci, internally hyaline or with yellowish golden, granular contents, branching at the base of the asci and towards the middle, septate, filiform, becoming slightly expanded at the apex and there 2-3µm wide, walls thin, smooth and hyaline. Subhymenium not well differentiated from the medullary excipulum, well developed, hyaline, in the center to ca to ca 30-40µm, consisting of generally loosely interwoven, more or less parallel, vertically oriented hyphae, the individual hyphae hyaline to rarely pigmented light brown, 1-3µm wide, the walls thin, hyaline and smooth. Medullary excipulum very well developed, comprising the vast majority of the apothecium, non-refractive, hyaline, consisting of sepate, branched, loosely interwoven (to parallel in the flanks and toward the margin) hyphae 1-2(-3)µm wide, the walls thin, non-refractive, hyaline and smooth. Ectal excipulum from base of stipe to margin constructed in the following manner: lower portion of apothecium composed of a zone to ca 50µm thick of angular to globose cells to the outside and to the inside composed of loosely to tightly interwoven hyphae 2-6(-8)µm wide, the individual cells hyaline to lightly pigmented with walls thin, hyaline and smooth; the outermost cells frequently giving rise to "hairs" 5-50µm long, 2-3µm wide at the slightly pointed apex, the walls thin to slightly thickened, hyaline, and smooth; in the flank the globose to angular cells replaced by narrow more or less parallel hyphae originating in the medullary excipulum, the hyphae towards the juncture with the stipe extending at high angles to the surface and becoming progressively at a lower angle toward the margin, lying parallel to the surface below the margin.

Specimens studied: Mexico, Oaxaca, in the vicinity of km 76, on the road from Oaxaca to Valle Nacional, on leaves of *Quercus*, 10 Aug 1967, K. P. Dumont s.n. (CUP-ME 144); data as 144, but occurring on pine needles (CUP-ME 146).

30. *Helotium flavo-aurantium* (Hennings) Rick, Brotéria, Sér. Bot. 25: 115. 1931.

≡ *Lanzia flavo-aurantia* Hennings, Hedwigia 41: 26. 1902.

NOTES. *Lanzia flavo-aurantia* was described on wood from south Brazil. It was transferred to *Helotium* by Rick (1931) and reported from Colombia by Cash (1937). I have examined a portion of the type deposited at S and conclude that it is the same as *Helotium rufo-corneum*. I, thus, place *Helotium flavo-aurantium* into synonymy with *H. rufo-corneum*, since the latter has priority. For a full discussion, see Dumont (1980).

The Cash (1937) report was based on a Martin collection, 3785, and is also *H. rufo-corneum*, a common neotropical lignicolous species.

Holotype: Lanzia flavo-aurantia - Brazil, Sta. Catharina, near Blumenau, A. Möller 259, wood, 26 Nov 1891 (ex S, herb Sydow).

Additional specimen studied: Colombia, Dpto. Magdelena, Sierra Nevada de Santa Marta, Cerro Quemado trial, G. W. Martin 3785, wood, 28 Aug 1935 (ex BPI as *Helotium flavo-aurantium*).

31. *Helotium fusco-brunneum* Patouillard & Gaillard, Bull. Soc. Mycol. France 4: 101. 1888. FIG. 7.

Stroma — Substratal, difficult to detect with the unaided eye, forming single or less commonly double black lines on the surface of the bark, or more easily observed when the wood is cut and then observed as dark lines just beneath the surface of the substrate and in association with the bases of the stipes of apothecia; the black lines composed of rind cells with differentially pigmented walls, irregular to epidermoid in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia variable, scattered or gregarious, arising in association with black line stromata, substipitate, stipe length less than the diameter of the receptacle, 2-4mm in diam, to ca 1mm high, when fresh disc concave, drying flat to concave, drying flat to concave, rehydrating slightly concave; when fresh "toute la plate est d'unrouxbrilliant," drying dark brick red to nearly black, when rehydrated in 2% KOH giving off a purple-red dye.

Apothecial anatomy — Asci 8-spored, 35-45x5-6µm, produced from small croziers, short cylindric-clavate, tapering toward the base and occasionally forming a small foot, wall thin to ca 1µm thick, at the rounded to subtruncate apex equal to side walls or slightly thicker; ascus reaction not observed. Ascospores 5-7x1.5-2.5µm, biseriate, obliquely uniseriate, or biseriate above and uniseriate below, hyaline, smooth, aseptate, ellipsoid or less commonly obovoid, ends rounded or slightly pointed, in outline inequilateral, flattened on one surface or commonly slightly curved, both ends more or less equal; guttules obscure, with two small, irregular, polar guttulate areas. Paraphyses equal to the tips of the asci, internally hyaline, branching towards the base of asci, sparingly septate, filiform, becoming slightly expanded at the apex and there 2-3µm wide, walls thin, smooth and hyaline. Subhymenium not well defined or differentiated from medullary excipulum, but with an indistinct zone beneath the base of the asci composed of hyphae slightly narrower and more compact than the medullary excipulum below, also with the zone pigmented light yellow-brown. Medullary excipulum well developed, well differentiated from the ectal excipulum and grading into the base of the asci, comprising the majority of the fruitbody, variable, non-refractive, hyaline or rarely slightly pigmented, consisting of loosely to tightly interwoven hyphae 3-7 µm wide, the walls thin or rarely thickened, smooth or rarely slightly roughened, hyaline to light brown. Ectal excipulum: inner ectal excipulum absent. Outer ectal excipulum well developed and well differentiated from the medullary excipulum, entire layer non-refractive, hyaline or pigmented light brown to the outside, very variable in thickness, and ca 20-45(-60) µm wide; consisting predominantly of a well-defined textura globulosa; the individual cells 4-8(-10)µm in diam, overlapping, frequently chain-like and oriented perpendicularly to the surface of the apothecium, globose to angular, the outermost cells light brown, to the inside hyaline, the walls thin to thickened, hyaline or pigmented, smooth or rarely roughened, the outermost cells unmodified; hairs absent. Margin constructed similarly to the receptacle, to the ouside with globose cells 4-6µm in diam, to the in-

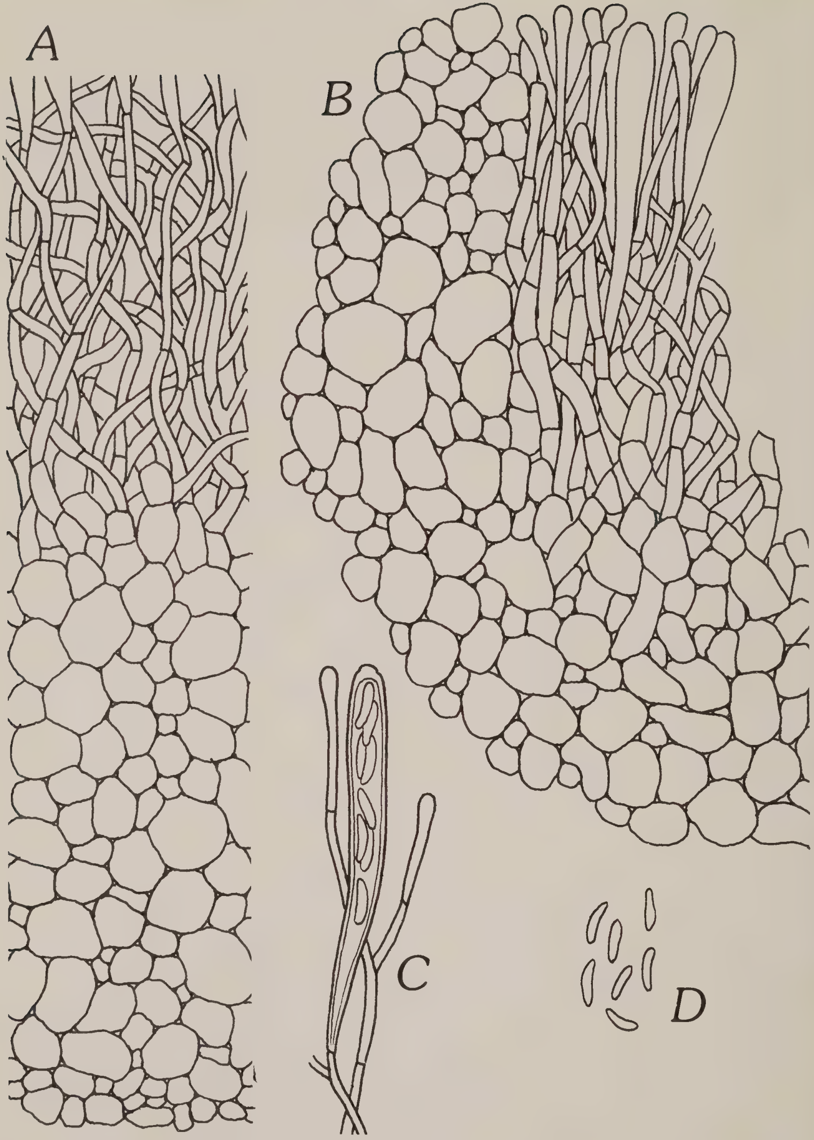


FIG. 7. *Moellerodiscus fusco-brunneus*, Gaillard 240, freehand drawings, x 1,000. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. B. Median longitudinal section of an apothecium through margin. C. An ascus with 8 ascospores and a paraphysis. D. 7 ascospores drawn after discharge from ascus.

side a zone to ca 15µm wide of narrow hyphae (paraphyses) terminating in expanded apical cells. Stipe constructed similarly to the receptacle, to the outside the outermost cells more intensely pigmented than those of the receptacle, and the internal hyphae maintaining a parallel orientation and only torn apart and interwoven in the center. Hairs absent.

Habitat: On wood.

Etymology of the specific epithet: refers to the color of the apothecium apparently in dry condition as the fruitbody was said to be reddish when fresh.

Holotype: Helotium fusco-brunneum - Venezuela, entre Maipures â San Fernando, sur ecorce d'arbre, 26 Août 87, Gaillard 240 (FH, PC).

Illustration: Le Gal, Discom. Madagascar p. 326, fig. 147. 1953.

NOTES. Helotium fusco-brunneum was described from wood in Venezuela. It was transferred to *Rutstroemia* by Le Gal (1953) who noted that the fungus produced a substratal stroma. Dennis (1970) transferred the species to *Ionomidotis* because the fruitbody yields a purple dye in ammonia. Since *Helotium fusco-brunneum* produces a stroma, I agree with Le Gal who placed the species in the Sclerotiniaceae, but conclude that it should be placed in the genus *Moellerodiscus* since the ectal excipulum is composed of a well developed textura globulosa to angularis and occurs on wood. The formal transfer is made here:

Moellerodiscus fuscobrunneus (Patouillard & Gaillard)
Dumont, comb. nov.

Basionym: Helotium fusco-brunneum Pat. & Gail., Bull. Soc. Mycol. France 4: 101. 1888.

Within the genus *Moellerodiscus* there are two additional species which emit a purple or reddish purple dye in ammonia or 2% KOH, *M. musae* and *M. guttulatus*. In *M. guttulatus* the ascospores have two large obvious polar guttules which fill most of the spore, separated by a narrow band of cytoplasm; in *M. fuscobrunneus* the ascospores have two tiny, polar guttulate areas and lack the distinct guttules of the former species. *Moellerodiscus fuscobrunneus* appears to be most closely related to *M. musae*. Dumont (1976) reported the ascospores of *M. musae* to be (3-)4-5(-6)x1.5-2(-2.5)µm, while those of *M. fuscobrunneus* are reported to be 5-7x1.5-2.5µm. The two species are best separated on the basis of the different ascospore shapes. In *M. musae* they are equilateral in outline, ovoid to subellipsoid and have two well-defined polar guttules, while in *M. fuscobrunneus* they are generally inequilateral, generally flattened on one side and slightly curved, and lack well-defined guttules. Since both species are known to me from so few collections, I do not fully understand their morphological and anatomical variation. Should the ascospore shape prove to be variable and an unreliable character, then it is possible that the two really represent one variable taxon. Until more collections are studied, I maintain them as distinct species.

32. *Helotium fuscopurpureum* Rehm, Hedwigia 39: 94. 1900.

NOTES. *Helotium fuscopurpureum* was described on wood from Brazil by Rehm (1900) and was transferred to *Hymenoscyphus* by Dennis (1964). I have examined the holotype deposited at S and conclude that it is the same as *Helotium rufo-corneum*, which has priority. For full discussion, see Dumont (1980).

Holotype: Helotium fuscobrunneum - Brazil, Serra dos Orgaos, on wood, Oct 1896, E. Ule 2500 (ex S, herb Rehm).

Illustration: Dennis, Kew Bull. 1954: 329, fig. 38. 1954.

33. *Helotium gedeanum* Dennis, Kew Bull. 1954: 322. 1954.
FIG. 8.

≡ *Cudoniella javanica* P. Hennings, Monsunia 1: 173. 1899.

NOTES. *Cudoniella javanica* was originally described by Hennings from Java. Dennis (1954) demonstrated that it should be placed in *Helotium*, but the name was preoccupied by a Penzig and Saccardo epithet. He proposed the new name *Helotium gedeanum* Dennis, and later transferred it to *Hymenoscyphus* as *H. javanicus* (Hennings) Dennis. Neither Dennis nor I have been able to locate the type of *C. javanica*.

Dennis (1954) reported the species from Jamaica based on one of his collections, Dennis J50, and provided a description and illustrations of the species. He described the ectal excipulum as being composed of tightly interwoven hyphae, which appear almost pseudoparenchymatous in section and covered by brown, thin walled hairs. In his illustrations, he pictures the individual cells as having their long axis parallel to the surface of the apothecium, and forming a well-layered textura prismatica.

The excipulum of this species is complex and difficult to interpret, and my observations differ somewhat from those of Dennis. It is my impression that the hyphae of the medullary excipulum are comprised of well-defined and loosely arranged textura intricata, and toward the outside the hyphae become more and more tightly compact, with some of the hyphae maintaining hyphal-orientation while others lose this orientation and the hyphae become disrupted, and the resulting structure is of irregular to globose cells. The outermost ca 100µm is then composed of very refractive individual cells maintaining a perpendicular orientation to the surface and individual hyphae which appear to be disoriented and contorted. The outside of the surface is covered with "hairs" which are lightly pigmented, strongly clavate, often capitate, or cylindric.

The structure is similar to that described for *Chlorencoelia* by Dixon (1975). According to this interpretation, Dennis's collection of *Hymenoscyphus javanicus* cannot be *Hymenoscyphus* as defined here. Since I have not located the type of this species, I cannot determine if the type is, in fact, an *Hymenoscyphus*. I am not now ready to propose a new type for *C. javanica* and thus merely question the report of *H. javanicus* from the neotropics. Should the Dennis collection turn out to be the same as the type, it will then be placed in a genus other than *Hymenoscyphus*.

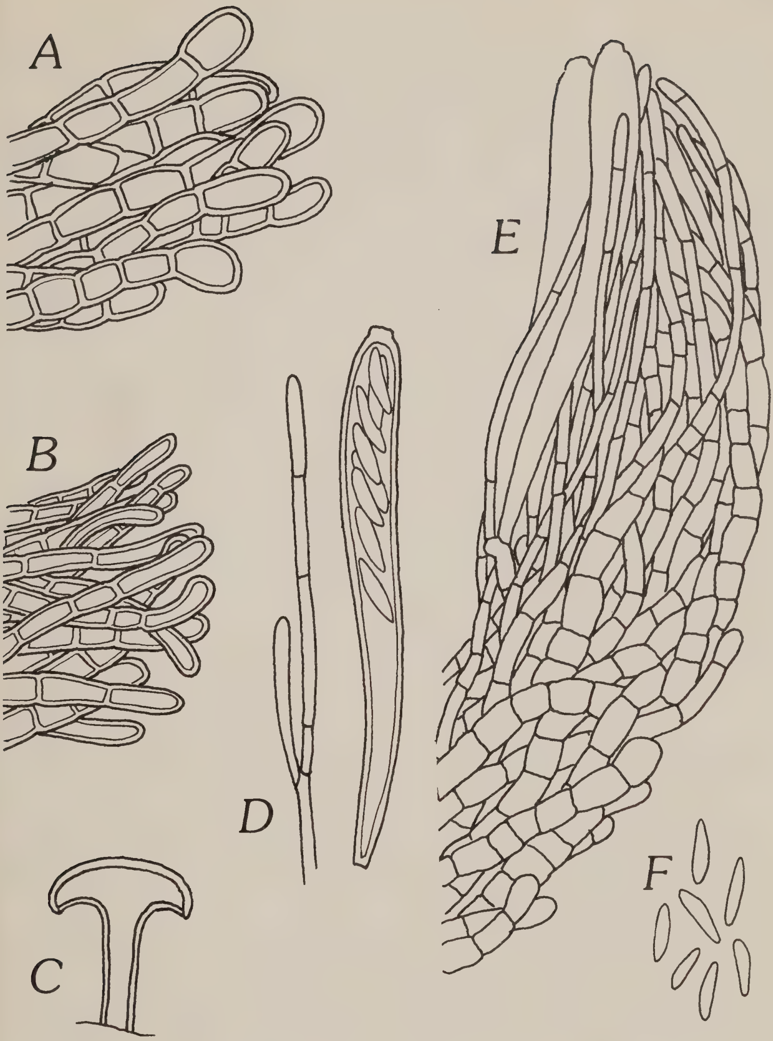


FIG. 8. *Helotium gedeanum*, Dennis J 50, freehand drawings. A. Hyphae on the surface of the stipe. B. Hyphae from the surface of the receptacle. C. Habit sketch of entire fruitbody (redrawn from Kew Bull. 1954: p. 322). D. An ascus with 8 ascospores and a paraphysis. E. Median longitudinal section of an apothecium through margin and upper portion of flank. F. 7 ascospores drawn after discharge from the ascus. A, B, D-F x 1,000; C, x ca 50.

The structure of the ectal excipulum is the same as that described by Dixon for *Chlorencoelia*. I have observed two short stipes and receptacles arising from a common larger stalk, but have not observed an ionomidotic reaction. However, I did see a yellow-brown dye given off in 2% KOH. The hymenium of the Dennis collection is dark brick-red, while the receptacle and stipe are blackish. With the combination of small asci, small ascospores, the complex excipulum described above, the characteristic tomentum hyphae, I refer the collection to *Chlorencoelia*. According to Dixon, this genus is separated from *Cordierites* by the lack of an ionomidotic reaction. I should also mention that the structure of the apothecium is very similar to *Bisporella*, which has a yellow color and lacks the hairs of *Chlorencoelia*.

Specimen studied: Jamaica, Blue Mountains, Mossman's Peak, logs, 22 Dec 49, R. W. G. Dennis J50 (ex K).

Illustration: Dennis, Kew Bull. 1954: 322, fig. 31. 1954.

34. *Helotium hyphicola* P. Hennings, Hedwigia 44: 69. 1905.

NOTES. Helotium hyphicola was described on twigs covered with hyphae of *Asterula corniculariiformis* from Amazonian Brazil. In the original description Hennings (1905) cited two collections, Ule 2829 and 2865, but did not designate either as the holotype. I have examined both collections deposited at HBG and conclude that they both represent the same taxon. I hereby designate Ule 2829 as the lectotype specimen of *Helotium hyphicola*. This collection was chosen instead of the other because it contains more apothecia.

This species is the same as what Carpenter & Dumont (1978) referred to as *Bisporella discedens*, which, as is suggested in this paper, is the same as *Bisporella sulfurina*.

Specimens cited: Brazil: Amazonas, Rio Jurua Mirim, dead wood, Oct 1901, Ule 2829 (Lectotype specimen of *Helotium hyphicola*, ex HBG); Amazonas, Rio Jurua Mirim, rotten wood, Oct 1901, Ule 2865 (syntype and now lectoparatype of *Helotium hyphicola*, ex HBG).

35. *Helotium irregulare* Rick, Brotéria, Sér. Bot. 25: 110. 1931.

NOTES. Helotium irregulare was described on wood from south Brazil. Dennis (1960a) mentioned a problem regarding reading the date on the label of the type of *H. irregulare*, deposited at PACA. The species was described in 1931 and Dennis interpreted the date to read "1939". I have concluded that the date should read "1929" and that the specimen deposited at PACA, 13213, and marked "Cotypus" is, in fact, the holotype specimen for *H. irregulare*.

Dennis suggested that *H. irregulare* could be synonymous with *H. leucopse*. I agree with him, and the latter name has priority. For full discussion, see notes under *H. leucopse* below.

Holotype: Helotium irregulare - Brazil, São Leopoldo, wood, June 1929, Rick (ex PACA 13213).

36. *Hymenoscyphus javanicus* (P. Hennings) Dennis, Persoonia 3: 77. 1964.

NOTES. See *Helotium gedeanum* for full discussion.

37. *Hymenoscyphus lasiopodius* (Patouillard) Dennis, Persoonia 2: 190. 1962.

≡ *Belonidium lasiopodium* Patouillard, Bull. Soc. Mycol. France 16: 184. 1900.

NOTES. According to Dumont & Carpenter (1981), *Hymenoscyphus lasiopodius* appears to be a common and widely occurring neotropical species. See Dumont & Carpenter for full description, discussion and illustrations.

38. *Helotium lasseri* Dennis, Kew Bull. 14: 432. 1960.
FIGS. 9, 10.

Stroma — Substratal, on the host difficult to detect with the unaided eye, visible in section as rind cells at the base of the stipe of the apothecium or as blackened areas of the host; the rind cells with differentially pigmented walls, epidermoid to irregular in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

Microconidial state — Unknown.

Apothecial morphology — Apothecia solitary, stipitate, 1-2mm in diam, 0.5mm high, when fresh disc concave, drying concave to flat, rehydrating concave to flat. Hymenium when fresh pallid, drying pinkish brown, rehydrating lighter; margin when fresh pallid, drying dirty white, rehydrating pallid to subtranslucent; receptacle when fresh pallid, drying white to off-white, rehydrating lighter; stipe cylindrical and short above, when fresh, dry, and rehydrated concolorous with the receptacle, darker below.

Apothecial anatomy — Asci 8-spored, (70-)75-85(-90)x(8-)9-11µm, produced from tiny croziers, clavate, gradually tapering towards the base and there forming a tiny foot, wall ca 1µm thick, enlarged at the rounded to truncate apex and there 2-3µm thick; pore J-. Ascospores (9-)10-11(-12)x 4-5µm, uniseriate to biseriate above and uniseriate below, in youth hyaline, smooth, aseptate, ellipsoid, ends rounded, in outline slightly inequilateral or rarely flattened on one side, both ends more or less equal or anterior end slightly broader; guttules poorly defined or obvious, two more or less equal or with anterior one slightly larger, irregularly shaped, large 1-2µm wide, polar or with two irregular guttulate areas; apparently discharged from the ascus while hyaline, becoming lightly pigmented after discharge, generally maintaining same shape or becoming slightly more expanded; guttules becoming more difficult to detect; walls faintly punctate; a few pigmented, punctuate, collapsed ascospores observed in apparently malfunctioning asci. Paraphyses equal to or slightly exceeding the asci, internally hyaline, branching at the base of the asci and toward the middle, rarely branching toward the apex, septate, filiform, becoming slightly expanded at the apex and there 1-2µm wide; walls

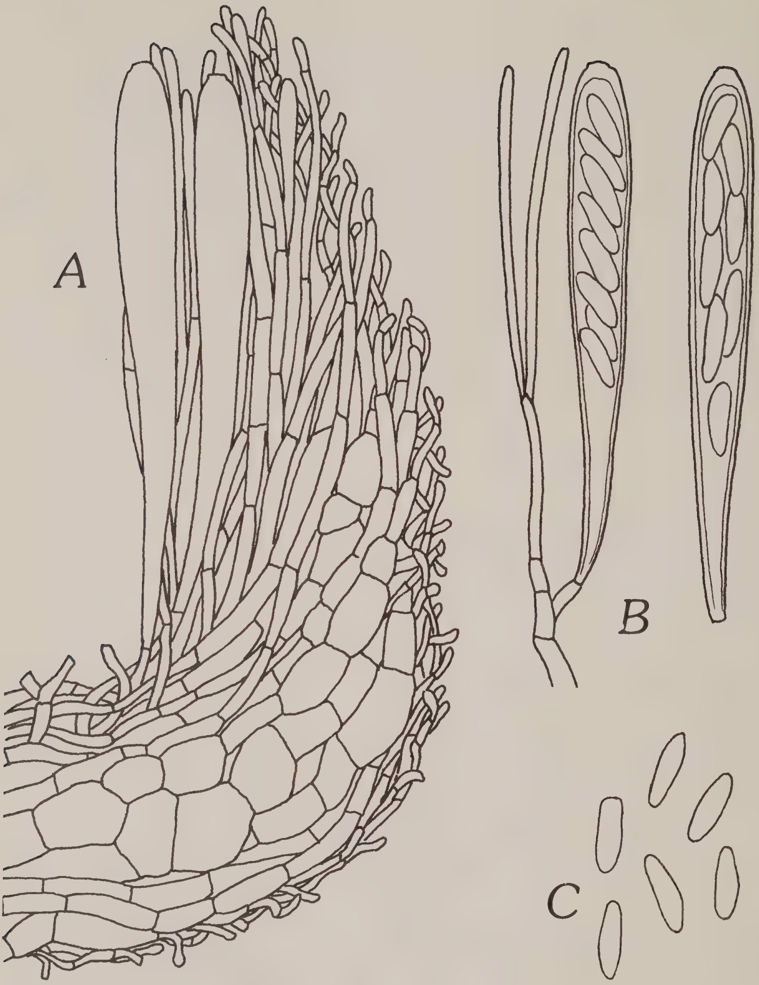


FIG. 9. *Lambertella lasseri*, Dennis 1814 ex K, freehand drawings, x 1,000. A. Median longitudinal section of an apothecium through margin. B. Left: A paraphysis and an ascus with 8 obliquely uniseriate ascospores; right: an ascus with 8 biseriate ascospores. C. 6 ascospores drawn after discharge from the ascus.

thin or rarely slightly expanded at the apex and there 1-2µm wide; walls thin or rarely slightly thickened, hyaline and smooth. Subhymenium well developed, pigmented light brown, in the center to ca 25µm wide, as narrow as 15µm at the margin, at the base of the asci consisting of generally very loosely interwoven, parallel, vertically oriented hyphae or towards

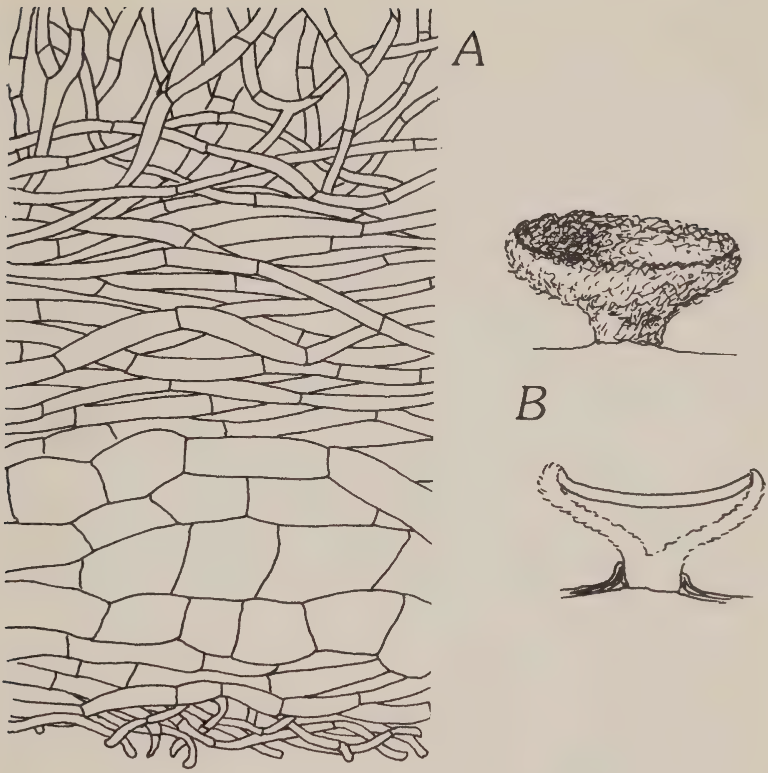


FIG. 10. *Lambertella lasseri*, Dennis 1814 ex K, freehand drawings. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe, x 1,000. B. Upper: habit sketch of apothecium on substrate; lower sketch of section of apothecium showing distribution of tissues, redrawn from Dennis (1960), x ca 50.

the medullary excipulum a narrow zone of hyphae extending parallel to the base of the asci, the individual hyphae lightly pigmented to hyaline, 1-2 µm wide, the walls thin to slightly thickened, pigmented, smooth or rarely roughened. Medullary excipulum poorly developed and nearly absent in the flanks, obconical, non-refractive, hyaline to pigmented light brown, consisting of septate, branched, loosely to moderately tightly interwoven (to parallel in the flanks) hyphae 2-5µm wide, the walls thin to slightly thickened, non-refractive, hyaline or pigmented light brown and smooth. Ectal excipulum: inner ectal excipulum well-defined and well-differentiated from outer ectal excipulum and medullary excipulum, entire layer non-refractive, lightly to moderately pigmented brown, to ca 8-10µm wide towards the margin and to ca 20µm wide towards the stipe, consisting of loosely to tightly compact, parallel to slightly interwoven, lightly to intensely pigmented hyphae 2-3(-4)µm wide, the walls thin, non-refractive, pigmented, smooth to rarely slightly roughened. Outer ectal excipulum non-refractive, non-gelatinized, entire layer hyaline to occasionally lightly pigmented, ca 15μm broad towards the margin and to ca 20-30μm wide toward the stipe, consisting predominantly of textura prismatica with the individual hyphae extending parallel to or at low angles to the surface of the apothecium; the individual cells towards the margin (5-)8-15x3-5(-8) μm, (8-)10-16(-22)x(5-)8-12μm towards the stipe, the walls thin, hyaline and smooth. Outer covering layer present, the individual hyphae extending parallel to the surface of the apothecium, overlapping, hyaline to more commonly pigmented light brown, the walls non-refractive, thin, generally lightly pigmented and smooth or rarely finely roughened. Hairs present, originating from intercalary cells of the outer covering layer, clothing the surface of the apothecium, individually short or long, becoming tightly interwoven and details becoming obscured and frequently appearing cellular and filamentous. Margin poorly developed, narrow above, broader below, entire layer light brown to intensely pigmented, constructed similarly to the apothecial flank below, the individual cells smaller, the narrow hyphae between the brick-shaped cells and the layer of asci and paraphyses becoming more intensely pigmented than the corresponding layer below. Stipe in the upper portion constructed similarly to the apothecial flank; at approximately midpoint to the outside an outer covering layer of narrow hyaline to pigmented hyphae with walls thin, pigmented, smooth to roughened, to the inside a zone of parallel hyphae with hyaline to brown, brick-shaped cells with walls thin, hyaline to brown, smooth to roughened and grading into a pigmented zone comprised of longer and narrower cells in the central core; rind cells visible at the base of the stipe at the junction with the substrate; hairs present, as on the receptacle.

Habitat: Leaves and twigs of small trees in the Melastomataceae.

Etymology of the specific epithet: refers to Dr. Tobias Lasser, the Director of VEN when Dr. Dennis, the collector of the type, collected in Venezuela.

Holotype: Helotium lasseri - Venezuela, west ridge of El Avila, above Caracas, Dto. Federal, leaves and shoots of small trees in Melastomataceae, 17 Aug 1958, R. W. G. Dennis 1814 (K).

Illustrations: Dennis, Kew Bull. 14: 432, fig. 4. 1960.

NOTES. *Helotium lasseri* was described on leaves and twigs from Venezuela and was transferred to *Hymenoscyphus* by Dennis (1964). In his original description Dennis (1960) indicated, "This is certainly not a typical *Helotium*..." With the presence of a stroma on the host, I conclude that it is a member of the Sclerotiniaceae, and because of the presence of pigmented and punctate ascospores, I place the species into *Lambertella*. In general, my other observations agree with those of Dennis (1960), but the single apothecium which I studied was perhaps somewhat poorly preserved, and some of my observations of the sterile tissue are thus subject to modification as more material is available for study of this species.

The species appears to be most closely related to *Lambertella tropicalis*, which has subreniform ascospores, 12-14x4-6 μm, and is most easily distinguished from the other species by the following combination of characters: J- asci, tightly interwoven hairs clothing the surface of the apothecium and ascospores (9-)10-11(-12)x4-5μm. I propose here the formal transfer to *Lambertella*:

Lambertella lasseri (Dennis) Dumont, comb. nov.

Basionym: Helotium lasseri Dennis, Kew Bull. 14: 432. 1960.

39. *Helotium leucopse* (Berkeley & Curtis) Le Gal, Prod. Flore Mycol. Madagascar 4: 335. 1953. FIG. 11.

≡ *Peziza leucopsis* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 368. 1868.
≡ *Hymenoscyphus leucopsis* (Berkeley & Curtis) Kuntze, Revis. gen. Pl. 3(3): 485. 1898.

Apothecial morphology — Apothecia variable, solitary to gregarious, stipitate, 4-7mm in diam, 2-4mm high, when fresh disc variable, characteristic, flat, irregular, convex, umbilicate, margin reflexed, wavy, lobed, drying strongly convex-umbilicate, rehydrated remaining convex. Hymenium when fresh variable, copper-colored, yellowish, pallid, off-white, drying pallid to flesh-colored, rehydrating pallid subtranslucent to light brown; margin generally concolorous with hymenium; receptacle generally slightly lighter than or concolorous with hymenium when fresh, dry or rehydrated; stipe in the upper portion concolorous with the lower portion of the receptacle, becoming dark brown towards the base of the stipe.

Apothecial anatomy — Asci 8-spored 38-52x4-5µm, produced from small croziers, cylindric-clavate, gradually tapering to the base and there forming a tiny foot or not; wall thin (less than 1µm), slightly enlarged at the rounded apex and there to ca 1µm thick; pore J+, the walls outlined blue in Melzer's Reagent. Ascospores (4-)5-7(-9)x1.5-2(-2.5)µm, obliquely uniseriate or biseriate above and uniseriate below, hyaline, smooth, aseptate, obovoid, pyriform, slipper-shaped, ends generally rounded or rounded above and slightly fusoid below, in outline generally equilateral, anterior end broader than posterior end; guttules generally present as two guttulate, indistinct, polar areas, anterior areas generally larger than posterior. Paraphyses equal to or rarely exceeding the asci, internally hyaline, branching at the base of the asci, septate, filiform, not noticeably expanded at the apex and there 1-2(-3)µm wide, walls thin, smooth, and hyaline. Subhymenium well-developed and well-differentiated from the medullary excipulum, hyaline or less commonly light yellow-brown, in the center to ca 30µm thick, as narrow as 15µm toward the margin; consisting of very tightly interwoven hyphae; the individual hyphae losing hyphal orientation and appearing cellular in many areas, hyaline or rarely light brown, 1-2µm wide, the walls thin, smooth and generally hyaline. Medullary excipulum well developed, obconical, non-refractive, hyaline, consisting of septate, branched, loosely to tightly interwoven (to parallel in the flanks and towards the margin) hyphae 3-7(-8)µm wide, the walls thin, hyaline, and smooth. Ectal excipulum: inner ectal exipulum absent. Outer ectal excipulum well developed, undifferentiated, grading into the medullary excipulum to the inside, entire layer non-refractive to slightly refractive, hyaline, to ca 30µm wide toward the margin and to 60µm wide toward the stipe, consisting of textura porrecta to a small celled textura prismatica with the individual hyphae tightly compact, frequently undulating, extending more or less parallel to the surface of the apothecium and parallel to each other or slightly interwoven, the individual cells towards the margin 5-22x3-4(-5)µm, toward the stipe the cells similar to those toward the margin or only slightly longer, the walls thin, or less commonly slightly thickened, hyaline or rarely pigmented light brown, but the outermost hyphae of the outer ectal excipulum occasionally lightly pigmented, brown and smooth. Outer covering layer absent. Hairs absent.

Margin simple, poorly developed, narrower above and broader below, entire layer hyaline or lightly pigmented yellow-brown, constructed similarly to the apothecial flanks below, the apically free cells unmodified. Stipe in the upper portion constructed similarly to the lower portion of the receptacle, below midpoint of the stipe and to the outside becoming lightly pigmented and becoming increasingly more intense toward the base of the stipe, the individual cells to the outside also frequently slightly rounded; rind cells absent. Hairs absent.

Habitat: On decorticated wood.

Etymology of the specific epithet: refers to the white color of the apothecium.

Holotype: Peziza leucopsis - Cuba, on dead wood, (date not indicated), C. Wright 372 (K).

Types of taxonomic synonyms: Holotype of *Helotium irregulare*: Brazil, São Leopoldo, on wood, 1929 (see notes below), Rick (ex PACA 13213). Neotype of *Helotium cupreum*: Brazil, São Leopoldo, on wood, Möller 54d (S).

Illustrations: Dennis, Kew Bull. 1954: 326, fig. 35 left. 1954. Dennis, Kew Bull. 1954: 326, fig. 35 right. 1954 (as *Helotium cupreum*). Le Gal, Prod. Flore Mycol. Madagascar 4: p. 336, fig. 150. 1953.

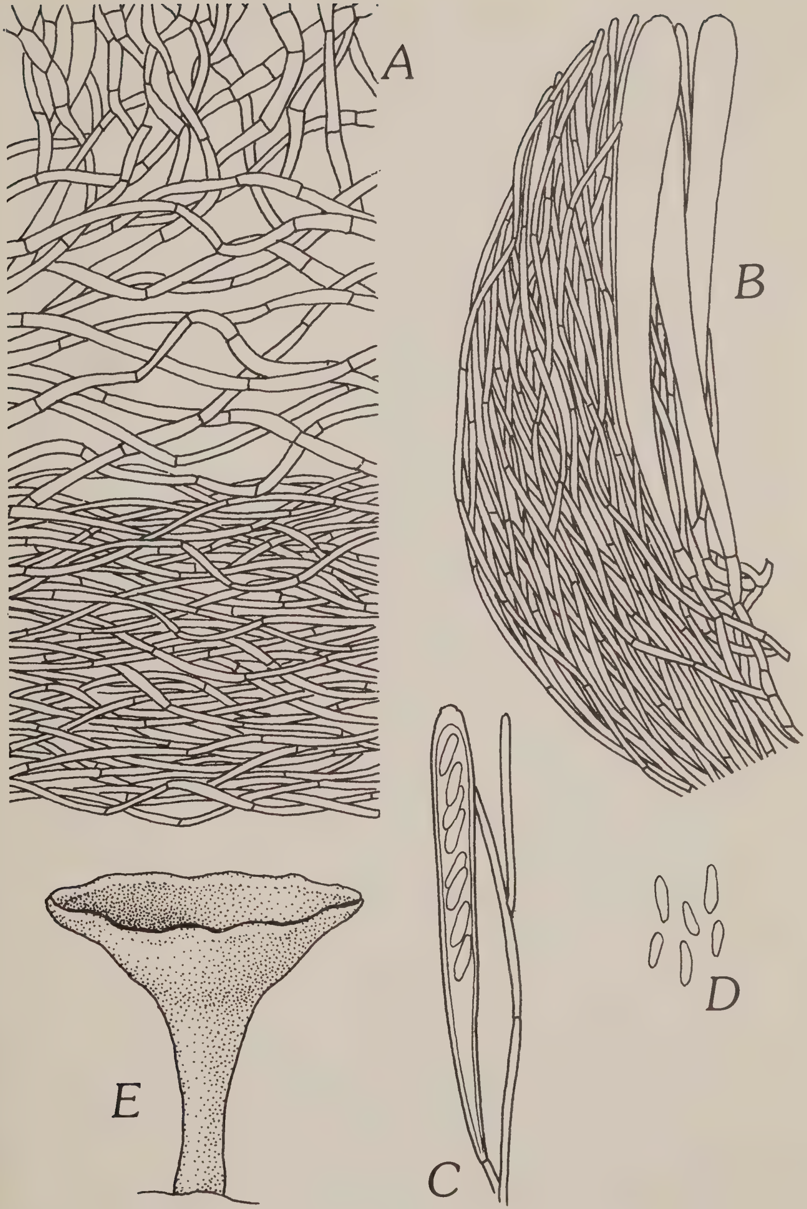
NOTES. Peziza leucopsis was originally described from Cuba by Berkeley & Curtis in Berkeley (1869), was based on a Wright collection 372, and was later transferred to *Hymenoscyphus* by Kuntze (1898) and to *Helotium* by Le Gal (1953). Dennis (1954) suggested that another neotropical *Helotium* might be closely related to it, *Helotium cupreum*, and further suggested that *H. irregulare* and *H. cupreum*..."ought probably to be reduced to synonymy under *H. leucopse*..." Dennis (1964) did, however, recognize at least two of these as distinct species, *H. leucopse* and *H. cupreum*, and placed them into *Hymenoscyphus*.

I agree with Dennis that the species should be placed in *Hymenoscyphus*, but after having examined the types of both *Helotium irregulare* and *H. cupreum*, I concluded that both are later taxonomic synonyms of *H. leucopse*, which has priority. I am uncertain as to its other affinities in the genus. The following combination of characters make this species readily separate from other species in the genus: small, obovoid to pyriform ascospores, undifferentiated ectal excipulum composed of narrow, parallel to undulating hyphae, its occurrence on wood, and large irregular apothecia.

40. *Helotium leucopus* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 410. 1853.

NOTES. Helotium leucopus was described from Chile on leaves of *Persea lingue*, and in the original description nei-

FIG. 11. *Hymenoscyphus leucopsis*, Wright 372 ex K, freehand drawings. A. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. B. Median longitudinal section of an apothecium through margin. C. An ascus with 8 ascospores and a paraphysis. D. 6 ascospores drawn after discharge from the ascus. E. Habit sketch of apothecium on substrate. A-D x 1,000; E x ca 50.


A
B
C
D
E

ther ascospore nor ascus measurements were given. Dennis (1961) reported the species from New Zealand and reported the ascospores in the type collection and in the one from New Zealand to be 18-22x4-5.5µm and to contain 4-6 well developed guttules. According to Dennis the species was thus very closely related to *Hymenoscyphus caudatus*. I have attempted to borrow the type of *H. leucopus* from PC, but have received only a photocopy of a plate with no apothecial material to study. Without type or authentic material to study, I must rely on the original description and Dennis's comments. If as Dennis has suggested, *H. leucopus* and *H. caudatus* can be separated by the guttules in the ascospores, then we must consider the two as distinct species. Dumont & Carpenter (1981) have reported *H. caudatus* from Venezuela, Colombia, Panama, Ecuador and southern Peru, and concluded that the ascospores in the neotropical collections did, in fact, have guttules. If this is the case, then ascospore guttulation is a doubtful criterion to be used in separating the two.

Until type or authentic material is available for *H. leucopus*, I can only consider it as a possible synonym of *H. caudatus*. If, in the final analysis they are demonstrated to be the same, then the epithet "*leucopus*" must be adopted, since it has priority. *Helotium leucopus* was described in 1853 and *H. caudatum* by Karsten in 1866.

41. *Helotium lividum* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 407. 1853.

NOTES. *Helotium lividum* was described from Chile as occurring on leaves of *Aextoxicum punctatum*. I have examined the presumed holotype deposited at PC and find the specimen very poorly preserved, and the single apothecium studied possibly attacked by a member of the Fungi Imperfecti. In the majority of the sterile tissue, I have not been able to determine the specific tissue composition and details of the hyphae. The medullary excipulum is composed of interwoven hyphae, while the ectal excipulum is composed of long, narrow hyphae, which are generally collapsed in this specimen. It is probable that the excipulum is composed of either a textura prismatica or porrecta, and I have seen no indication of a gelatinous matrix. I have noted a rather high proportion of misshapen and contorted ascospores, but the normal ascospores seem to be 4-6x2(-3)µm, obovoid, biguttulate, the ends were frequently slightly pointed to rounded and hyaline with no indication of pigmentation.

The apothecia on the leaves were substipitate with a very short stipe. I detected black line stromata extending irregularly along the surfaces of the leaf blade, and in section, I have seen well developed rind cells at the base of the stipe attached to the leaf. I conclude, therefore, that the species belongs in *Lanzia* in the Sclerotiniaceae and propose the formal transfer:

Lanzia livida (Montagne in Gay) Dumont, comb. nov.

Basionym: Helotium lividum Montagne in Gay, Historia Física y Política Chile, Botánica 7: 407. 1853.

Because of the state of preservation of the type specimen, I am unable to determine to what species *Lanzia livida* is most closely related or what its closest relatives are. Because of the small size of the ascospores, *L. livida* could be confused with *Lambertella microspora*, which has lightly pigmented ascospores. *Lanzia livida* could also be confused with *Helotium leucopse*, which also has small ascospores, but occurs on wood. In *L. livida* a stroma is produced, but it is absent in *H. leucopse*.

Presumed holotype: Helotium lividum - Chile, Valdivia, leaves of *Aextoxicum punctatum*, date not given, M. Gay s.n. (PC).

42. *Helotium lobatum* Starbäck, Bih. Kongl. Svenska Vetensk. Akad. Handl. 25(3,1): 5. 1899.

NOTES. *Helotium lobatum* was originally described on wood from south Brazil and was subsequently reported again from Brazil by Rick (1906, 1907, 1931) and appears to be a widely distributed neotropical species. Dennis (1954) tranferred the species to *Encoelia*; however, I am not prepared to transfer it to *Phibalis*, which was shown by Korf & Kohn (1976) to be an older name for *Encoelia*, since that generic name has been proposed as a *nomen rejiciendum*. I am uncertain as to the current circumscription of *Encoelia*, and this species further shows affinities to *Mollisia*. I thus, reserve judgement as to the placement of *Helotium lobatum* until the limits between the Dermateaceae and members of the Encoelioideae are better clarified and understood. For a complete description and illustration, see Dennis (1954).

Holotype: Helotium lobatum - Brazil, Rio Grande do Sul, Santa Angelo pr. Cachoeira, 4 II 1893, G. A. Malme 234 (not examined).

Illustration: Dennis, Kew Bull. 1954: p. 335, fig. 44. 1954.

Specimens studied: Brazil: S. Leopoldo, decorticated wood, 1929, Braun (ex PACA 13202); São Salvador, wood, June 1942, Rick (ex PACA 13203); São Leopoldo, wood, 1905, Rick (Fungi Austro-americana 83, ex PACA 13208); São Salvador, wood, 15 May 1944, Rick (ex PACA 22593); São Leopoldo, wood, 1930, Rick (ex PACA); Sao Leopoldo, wood, 1929, Braun (ex PACA 13223); São Leopoldo, wood, May 1929, Braun (ex PACA 13224); São Leopoldo, wood, 1930, Rick (ex PACA 13211); São Leopoldo, wood, 1905, Rick (ex PACA 13214); Mexico, Morelos, Cuernavaca, path to Salte de Antonio, living bark at base of elm tree, 31 Aug 1965, M. B. Spevak (CUP-ME 70).

43. *Helotium luteum* Rick, Brotéria, Sér. Bot. 25: 110. 1931.

NOTES. *Helotium luteum* was described on wood from south Brazil, and Dennis (1960) suggested that the species should be referred to *Phaeohelotium*, but did not make the actual transfer. I have examined the type collection of *H. luteum*, and conclude, as did Dennis, that it is a member of *Phaeohelotium*. Further, I have compared this collection with the type of *Phaeohelotium flavum* Kanouse, the type of *Phaeohelotium*, and find the two to be extremely closely related, if not the same taxon.

In *Helotium luteum* the ascospores and asci are respectively (16-)18-22(-24)x(4-)5-6(-8)µm and 120-140x9-11µm, while in *P. flavum* they are (12-)14-16(-18)x4-5µm and 95-100x7-10µm. In both species the spores become 1-septate and in *P. flavum* they are occasionally pigmented. However, there are instances when pigmented ascospores cannot be located; I have not observed pigmented ascospores in *H. luteum*. In both species there are internal guttules, generally broader above than below, and occasionally slightly curved. Both species produce sessile to turbinate apothecia which are yellow in fresh condition, and are to ca 2mm wide in *P. flavum* and to 4mm in *H. luteum*.

In the two species the structure of the sterile tissue is similar. Towards the base of the receptacle, the outermost tissues are composed or irregularly arranged globose to angular cells, which begin to form hyphae oriented perpendicularly to the surface of the apothecium. The individual hyphae then extend at high angles to the surface and progressing towards the margin the angle becomes less and less, until they are parallel at the margin.

As Dennis (1964) has pointed out, *Helotium monticolum* Berkeley is an older name for *P. flavum*. I have compared the Rick type with the types of *H. monticolum* and *P. flavum* and agree with Dennis that *H. monticolum* represents an older name for *P. flavum*. I further agree that *Helotium luteum* is a *Phaeohelotium*, and conclude from my studies, based on limited material of *H. luteum*, that they represent very closely related, but distinct species. I recognize, that the two species are known from widely disjunct areas. However, to date I have not knowingly collected and/or identified either one of these species from the neotropical region. It is still possible, though unlikely, that intermediate forms will be discovered. In view of this, I thus, propose the formal transfer to *Phaeohelotium* as follows:

Phaeohelotium luteum (Rick) Dumont, comb. nov.

Basionym: Helotium luteum Rick, Brotéria, Sér. Bot. 25: 110. 1931.

Habitat: On wood.

Etymology of the specific epithet: refers to the yellow color of the apothecia produced by the species.

Holotype: Brazil, São Leopoldo, wood, 1929, Rick (ex PACA 13232).

Illustration: Dennis, Kew Bull. 14: fig. 7, p. 121. 1960.

Additional specimens of Phaeohelotium monticolum studied: Michigan: Harbor Springs, wood, 9 Sept 1931, E. B. Mains 31-895 (ex MICH, holotype *Phaeohelotium flavum*); Pinckney, George Reserve, oak stump, 10 Nov 1931, A. H. Smith (ex MICH, paratype of *Phaeohelotium flavum*); Munsing, Miner's Falls, mossy log, E. B. Mains 32-578 (ex MICH, paratype of *Phaeohelotium flavum*). North Carolina, mountains, decorticated wood, 22 Jul 1856, M. A. Curtis 4471 (ex NY herb Massee, isotype of *Helotium monticolum*).

44. *Helotium miniatum* Patouillard in Duss, Champ. Guadeloupe & Martinique, p. 65. 1903.

NOTES. Helotium miniatum was described as occurring on wood from Guadeloupe. Dennis (1954) suggested that this species, *H. fuscopurpureum*, and *H. aurantio-rubrum* might represent the same species, but in 1964 Dennis placed the first two into *Hymenoscyphus*. I have studied the type specimens of both and find them to be the same species; and as discussed elsewhere(Dumont, 1980), *H. rufo-corneum* is the oldest name and must be used. I place *H. miniatum* into synonymy with *H. rufo-corneum*.

45. *Helotium miserum* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1969.

NOTES. *Helotium miserum* was described from Cuba as occurring on bark and soil. As Dennis (1954) has pointed out, this is neither *Helotium* or *Hymenoscyphus*, rather it is more closely related to the lichens, and will not be considered further here.

46. *Hymenoscyphus musicola* (Dennis) Dennis, Persoonia 2: 190. 1962. FIG. 12.

≡ *Belonidium sclerogenum* (Berkeley & Curtis) Saccardo var. *musicola* Dennis, Kew Bull. 13: 461. 1959.

Apothecial morphology — Apothecia scattered on the substrate, stipitate, ca 1.5mm diam and approximately same in height; receptacle saucer-shaped, when fresh, dry and rehydrated, and hymenium slightly umbilicate. Hymenium, receptacle and stipe generally concolorous when fresh, dry and rehydrated; when fresh "pallid," drying dark yellow, flesh-colored or light reddish brown, rehydrating lighter.

Apothecial anatomy — Asci 8-spored, (90-)100-110x9-11μm, probably produced from small croziers, details obscured owing to staining of material, broad cylindric-clavate, gradually tapering towards the base and there becoming slightly expanded to form a small foot, wall 1-2μm thick, enlarged at the truncate apex and there 3-4(-5)μm thick; pore J+, the walls outlined light to dark blue in Melzer's Reagent. Ascospores (17-)18-22(-24)x 4-5(-6)μm, generally biseriate throughout or uniseriate above and biseriate below, hyaline, smooth, 1(-?3)-septate, ellipsoid, obvoid, ovoid-reniform, ends generally rounded or rarely slightly pointed, in outline inequilateral, frequently curved, anterior end generally broader than posterior; well-defined guttules absent, but with 2-4 irregular, indistinct, large guttulate areas frequently occupying majority of some ascospores, located in bipolar position and/or adjacent to the nearly median septum. Paraphyses slightly exceeding the asci by 5μm, internally hyaline, branching not observed, septate, cylindrical, at the apex 2-3μm wide, walls thin, smooth and hyaline. Subhymenium not a distinct, recognizable layer, undifferentiated from the medullary excipulum. Medullary excipulum well developed in the center, less in the flanks, obconical, non-refractive, hyaline, consisting of tightly compact, septate, branched, interwoven hyphae 3-4(-5)μm wide, the walls thin, hyaline and smooth. Ectal excipulum: inner ectal excipulum well-defined, well-differentiated from the outer ectal excipulum and grading into the medullary excipulum, entire layer non-refractive, hyaline or pigmented light yellow-brown towards the margin, to ca 12μm wide toward the margin and to ca 25μm toward the stipe, consisting of tightly compact, hyaline or lightly pigmented brown hyphae 2-3μm wide, the walls thin, non-refractive, hyaline or rarely light brown and smooth.

Outer ectal excipulum non-refractive, non-gelatinized, entire layer hyaline, ca 15µm broad towards the margin and to ca 25µm broad toward the stipe, consisting predominantly of a large-celled textura prismatica with the individual hyphae extending at low to high angles to the surface and continuing to the surface and with the apical cells overlapping and covering the surface, the individual cells towards the margin 10-18(-22)x4-8 µm and 16-26x(10-)12-15(-17)µm toward the stipe, the walls thin, hyaline, and smooth. Outer covering and hairs absent, but with the apical cells of the outer ectal excipulum continuing to the surface, overlapping and covering the majority of the surface, the individual cells 4-9µm wide toward the base, clavate and slightly broad towards the apex, hyaline or pigmented to light brown, smooth or rarely roughened. Margin well developed, narrower above, broader below, entire layer lightly pigmented yellow-brown to darkly pigmented, constructed similarly to the apothecial flanks below, the individual cells smaller and the pigmentation more intense, the apical cells slightly expanded and rarely subcapitate and 5-7µm wide. Stipe in the upper portion constructed as the lower portion of the receptacle, toward the base the hyphae becoming narrower, and more or less interwoven, and slightly refractive. Hairs absent.

Habitat: On *Musa sapientum*.

Etymology of the specific epithet: refers to the host of the type collection.

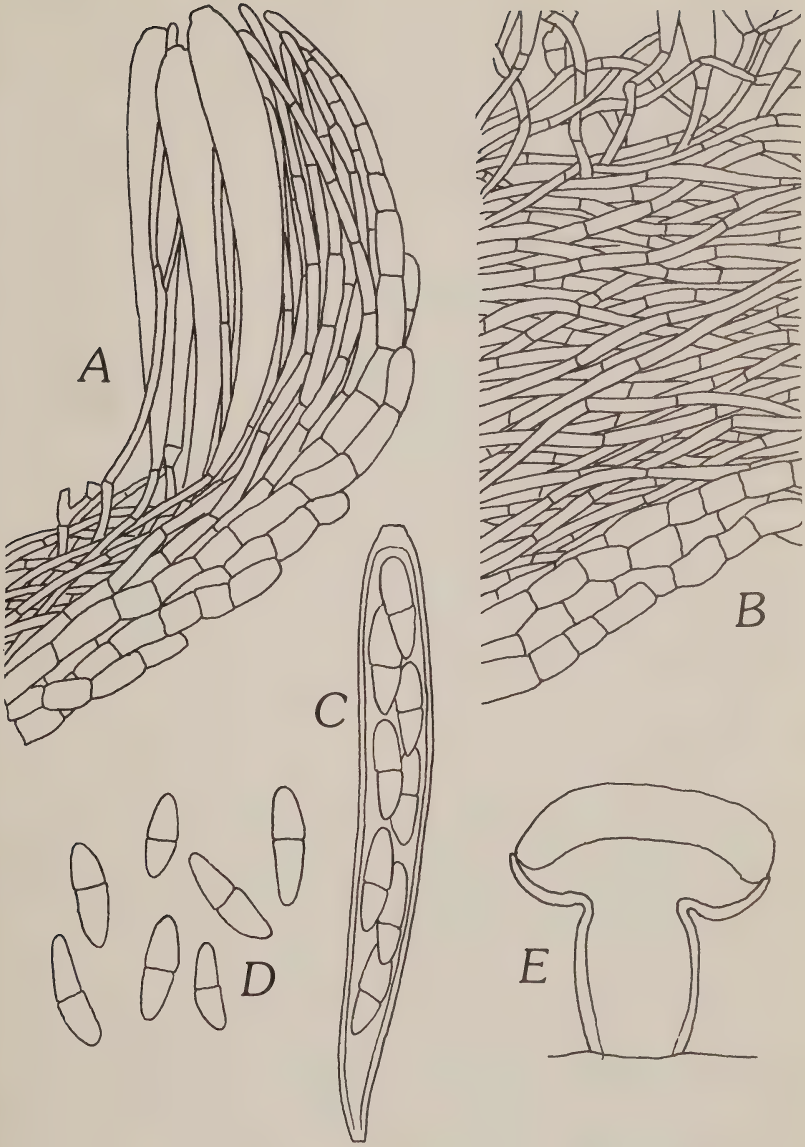
Holotype: Belonidium sclerogenum var. *musicola* - Bolivia, Coroico, Prov. Nor-Yungas, Dpto. La Paz, on *Musa sapientum*, 26 Jan 1956, R. Singer B. 553 (K).

NOTES. Dennis (1958) originally described *Belonidium sclerogenum* var. *musicola* from a Singer collection from Bolivia, and later (Dennis, 1962a) raised the variety to specific rank and transferred it to *Hymenoscyphus*, a decision with which I concur.

Hymenoscyphus musicola appears to be most closely related to two additional neotropical species studied by Dumont & Carpenter (1981), *H. sclerogenus* and *H. lasiopodius*. In *H. sclerogenus*, the ascospores are generally aseptate, or occasionally 1-septate, (22-)26-30(-35)x3-4(-6)µm, and have a nuclear staining area as reported by Dumont & Carpenter (1981); in *H. musicola* the ascospores are regularly 1-septate, (17-)18-22(-24)x4-5(-6)µm, and lack the staining nuclear area. In *H. lasiopodius* the ascospores are 3-septate, or rarely 1-septate, (20-)24-30(-35)x4-5(-6)µm, and the stipe produces obvious and characteristic hairs, while in *H. musicola* the ascospores are generally 1-septate, smaller, and the stipe lacks the hairs of *H. lasiopodius*.

Dennis (1958) reported the ascospores of *Belonidium sclerogenum* var. *musicola* to be 3-septate, whereas I have noted only

FIG. 12. *Hymenoscyphus musicola*, Singer B 553 ex K, freehand drawings. A. Median longitudinal section of an apothecium through margin. B. Median longitudinal section of an apothecium at approximately midpoint between margin and stipe. C. An ascus with 8 biseriate, 1-septate ascospores. D. 6 ascospores drawn after discharge from ascus. E. Habit sketch of an apothecium on substrate. A-D x 1,000; E x ca 50.


A
B
C
D
E

1-septate ascospores, with the possibility of an occasionally 3-septate ascospore.

47. *Helotium nigripes* (Fries) Fries, Summa veg. Scand., p. 356. 1849.

NOTES. Helotium nigripes was reported from Cuba by Berkeley (1869) and was based on a Curtis collection (634). I have examined the collection deposited at FH and find the collection to represent a species of *Bisporella*; it will not be considered further here.

Rick (1931) described *Helotium nigripes* var. *brasiliense* from south Brazil as occurring on wood, but failed to designate a holotype. I have examined four collections so identified in the Rick Herbarium, 13205, 13209, 13227, and 20220. The last collection was made after the species was described, July 1943, while the other three were doubtless the collections upon which Rick based his description. I designate herewith number 13227 as the type as it fits the protologue well. All four collections represent the same species of *Hymenoscyphus*. I place this variety into synonymy with *H. leucopsis*.

Lectotype: Helotium nigripes var. *brasiliense* - Brazil, São Leopoldo, on wood, 1929, Rick s.n. (ex PACA, herb Rick 13227).

Specimens studied: Cuba: dead wood, "Aug.", Wright 634 (ex FH, Fung. Cub. no. 701, herb Curtis). Brazil: São Leopoldo, wood, 1929, Braun (ex PACA, herb Rick 13205); São Leopoldo, wood, June 1929, Braun (ex PACA, herb. Rick 13209); São Salvador, wood, July 1943, Rick (ex PACA, herb. Rick 20220).

48. *Helotium ombrophiloides* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. Helotium ombrophiloides was described by Rick from south Brazil as occurring on mixed fragmentary plant debris. As Dennis (1960a) has pointed out, neither type nor authentic material of this species can be located in the Rick Herbarium, and from the brief description given by Rick, I am unable to speculate as to where the species could be placed. I will not consider the species further.

49. *Helotium pallidulum* Saccardo, Atti Soc. Venet. - Trent. Sci. Nat. 4: 36 (reprint no.). 1875.

NOTES. Helotium pallidulum was described by Saccardo from Italy as occurring on wood and reported from Brazil by Rick (1931). The specimens upon which the report was based cannot now be located in the Rick Herbarium, and it is impossible to verify this report; nor is it possible from the description, to determine exactly what Rick had, although from the description, it could be a species of *Orbilia* or *Bisporella*.

50. *Helotium persoonii* Montagne in Gay, Historia Física y Política Chile, Botanica 7: 410. 1853.

NOTES. *Helotium persoonii* was described from Chile by Montagne (1853) as occurring on wood. The holotype specimen cannot now be located at PC. Without type or authentic material, it is impossible to tell from the description what the species actually is. The description is suggestive of a species of *Orbilia*.

51. *Helotium pezizoideum* Cooke & Phillips in Cooke, Grevillea 19: 72. 1891.

NOTES. *Helotium pezizoideum* was originally described by Cooke & Phillips from New Zealand. The species was reported from Panama by Cash (1937), based on a Martin collection (2410). I have examined the Martin collection and find that it is not an *Helotium* or *Hymenoscyphus*, but rather is probably a member of the genus *Bisporella*. A final placement of this species can be made only after my studies are completed, and until that time, I cannot treat the collection further.

Specimen studied: Panama: Prov. Chiriquí, Valley of upper Rio Chiriquí Viejo, alt. 1600-1800 M, wood, 2 Jul 1935, G. W. Martin 2410 (ex BPI).

52. *Helotium phlebophorum* Patouillard, Bull. Soc. Mycol. France 18: 179. 1902.

NOTES. *Helotium phlebophorum* was described on leaves from Guadeloupe. Dennis (1962) transferred the species to *Ciboriopsis*. Dumont (1976) demonstrated that *Moellerodiscus* was an older name for *Ciboriopsis*, and placed *H. phlebophorum* into synonymy with *Moellerodiscus lentus* (Berkeley & Broome) Dumont. For full descriptions, illustrations and synonymy, see Dumont (1976) and Dennis (1954, 1962).

53. *Helotium radicola* P. Hennings, Hedwigia 41: 24. 1902.

NOTES. *Helotium radicola* was originally described from a Möller collection from south Brazil growing on decaying roots. I have been unable to locate Möller 668, the holotype specimen, at B, S, K, BPI, NY, CUP, Munich, and am unable to determine with any degree of certainty what this neotropical species is. Lignicolous species of *Hymenoscyphus* (Leotiaceae) or *Lanzia* (Sclerotiniaceae) with the small ascospore measurements (4-5x1.5µm) given by Hennings (1902) are uncommon. The most common appears to be *Helotium leucopse*, which is a species with larger ascocarps. *Helotium microspermum* Speg., a species from Argentina, also has small ascospores, but the fruitbodies are also much larger than those reported in the original description of *H. radicola*. In view of the lack of type or authentic material, I am unable to determine where this species should be placed.

54. *Helotium rhytidodes* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1869.

NOTES. *Helotium rhytidodes* is a corticolous species described from Cuba and based on Wright 373. I agree with Dennis who suggested that the species is probably an operculate

Discomycete and could be a member of the genus *Sarcoscypha*. Since it is an operculate Discomycete, it will not be treated further here.

55. *Helotium rufo-corneum* Berkeley & Broome, J. Linn. Soc., Bot. 14: 108. 1873.

NOTES. Dumont (1980) has recently published an extensive study on this species. Consult this work for detailed description, illustrations, and discussion.

56. *Hymenoscyphus sclerogenus* (Berkeley & Curtis) Dennis, Persoonia 2: 190. 1962.

≡ *Peziza sclerogena* Berkeley & Curtis in Berkeley, J. Linn. Soc., Bot. 10: 369. 1868.

NOTES. *Hymenoscyphus sclerogenus* was originally described from a collection on palm petioles from Cuba. Dumont & Carpenter (1981) have fully described and illustrated the species and discussed at some length the variability of the morphological features of the fruitbody and the wide substrate range. I agree with the Dumont & Carpenter treatment of this species and accept it as a valid species of *Hymenoscyphus*.

57. *Helotium scutula* (Persoon) Karsten, Not. Sällsk, Fauna Fl. Fenn. Forh. 11: 233. 1870.

≡ *Peziza scutula* Persoon, Mycol. Eur. 1: 284. 1822.
≡ *Hymenoscyphus scutula* (Persoon ex Persoon) Phillips, British Discomycetes p. 136. 1887.

NOTES. Dumont & Carpenter (1981) have recently discussed this species in detail. See that publication for full descriptions, illustrations, and discussion, as *Hymenoscyphus scutula*.

58. *Helotium serotinum* (Persoon ex Persoon) Fries, Summa veg. Scand. p. 355. 1849.

≡ *Peziza serotina* Persoon, Syn. Meth. Fung. p. 661. 1801.
≡ *Peziza serotina* Persoon ex Persoon, Mycol. Eur. 1: 292. 1822.

NOTES. Dumont & Carpenter (1981) have recently discussed this species in detail, have recorded it from the neotropics, and have accepted its placement in *Hymenoscyphus*. For a full description, discussion, and illustrations, see that paper.

59. *Helotium singeri* Dennis, Kew Bull. 13: 463. 1959.

NOTES. *Helotium singeri* was described on a pteridophyte and possibly dead palm leaves from Bolivia. I have examined the type deposited at K and find this to represent *Lambertella microspora* (Seaver) Dumont. This is a very common and widespread neotropical species which is not always recognized as a *Lambertella* because the ascospores only become lightly pigmented in the ascus, developing full pigmentation after discharge from the ascus. For full descriptions, illustrations, and discussion of this species, see Dumont (1971) under the name *Lambertella pallidispora* Dumont.

Holotype: Helotium singeri - Bolivia: Prov. Nor. Yungas, Rio Yariza, Dpto. La Paz, elev. 1400-1500, pteridophyte and ? dead palm leaves, 23 Feb 1956, R. Singer B. 1415 (ex K).

60. *Helotium sloaneae* Patouillard, Bull. Soc. Mycol. France 16: 183. 1900.

NOTES. *Helotium sloaneae* was originally described from Guadeloupe as occurring on leaves. The type specimen cannot now be located at either PC or FH. Dumont (1980) has suggested that this species may be a synonym of *Helotium rufocorneum*. See Dumont (1980) for a full discussion.

61. *Hymenoscyphus spadiceo-ater* (Montagne) Dennis, Persoonia 3: 66. 1964.

≡ *Helotium spadiceo-atrum* (Montagne) Saccardo, Syll. Fung. 8: 236. 1889.

NOTES. *Peziza* (*Phialea*) *spadiceo-atra* Montagne was originally described from Juan Fernandez Island on leaves of *Gunnera scabra*. Dennis (1964) redescribed and illustrated the species and transferred the species to *Hymenoscyphus*. I have examined the type and find it to be the same species as *Lambertella chromoflava* (Rick) Dumont, which Dumont (1974) showed to be an older name for *Lambertella phaeoparaphysata* Dumont. *Peziza spadiceo-atra* represents a still older name and I thus propose the transfer as follows:

Lambertella spadiceo-atra (Montagne) Dumont, comb. nov.

Basionym: Peziza spadiceo-atra Montagne, Ann. Sci. Nat. Bot., sér. 2, 3: 352. 1835.

For full description, illustrations, and discussion, see Dumont (1971) under *Lambertella phaeoparaphysata* and for additional notes on nonmenclature and taxonomy, see Dumont (1974).

Holotype: Peziza spadiceo-atra - Juan Fernandez Islands, leaves of *Gunnera scabra*, Mai 1830, Bertero 1704 (ex FH, herb Patouillard).

62. *Helotium subcastaneum* Hennings in Saccardo & Sydow, Syll. Fung. 14: 764. 1899.

NOTES. *Helotium subcastaneum* is a renaming of *Helotium castaneum* P. Hennings, a later homonym of *Helotium castaneum* Saccardo & Ellis. See notes under *Helotium castaneum* above for a full discussion.

63. *Helotium subserotinum* P. Hennings & Nyman, Monsunia 1: 33. 1900.

NOTES. *Helotium subserotinum* was originally described as occurring on wood, from Java, but has not actually been reported from the neotropics. Dumont (1980) has placed the species into synonymy with *Helotium rufo-corneum*, a species widely distributed in the neotropics. Consult that paper for a full discussion.

64. *Helotium subturbinatum* P. Hennings, Hedwigia 36: 233. 1897.

NOTES. Helotium subturbinatum was originally described from south Brazil as occurring on twigs. I have been unable to locate type or authentic material of the species, and from the brief description am unable to determine what the species is. Rick (1931) also reported the species from Brazil and gave a near translation of the Hennings description. No specimen of *H. subturbinatum* can now be located in the Rick Herbarium.

I know very few neotropical species of *Hymenoscyphus*, *Lanzia* or *Poculum* occurring on wood with ascospores "19-24x5-6"µm with brown fruitbodies. One possibility could be *Hymenoscyphus serotinus* as defined by Dumont & Carpenter (1981). Until type or authentic material is available for study I cannot treat the species further here.

65. *Helotium sulfurellum* Ellis & Everhart, Bull. Torrey Bot. Club 10: 98. 1883.

NOTES. Helotium sulfurellum was described from the U.S. as occurring on leaves. The species was placed into synonymy with *Rutstroemia longipes* by White (1942). It was reported from Brazil by Rick (1906, 1931) as occurring on wood and leaves. I have studied the sole collection of this species in the Rick Herbarium and find in the packet, 13228, a single leaf devoid of any apothecia. The leaf does contain abundant line stroma and darkened areas which could represent the stroma of a species of Sclerotiniaceae. I am unable to verify the Rick reports, and the species is unknown to me from the neotropics.

66. *Helotium tectum* Rick, Brotéria, Sér. Bot. 25: 109. 1931.

NOTES. Helotium tectum was described from Brazil as occurring on leaves. No type or authentic material of this species can now be located. When Rick described the species he failed to give the ascospores measurements, and for this reason, I cannot hazard a guess as to what the species could be.

67. *Helotium titubans* Montagne in Gay, Historia Física y Política Chile, Botánica 7: 408. 1853.

≡ *Hymenoscyphus titubans* (Mont. in Gay) Dennis, Persoonia 3: 76. 1964.

Stroma — Substratal, variable, visible on the host as black lines extending irregularly along the surface of the leaf; the black lines in section composed of rind cells with differentially pigmented walls, epidermoid to irregular in face view; not known in culture.

Macroconidial state — Unknown, presumed absent.

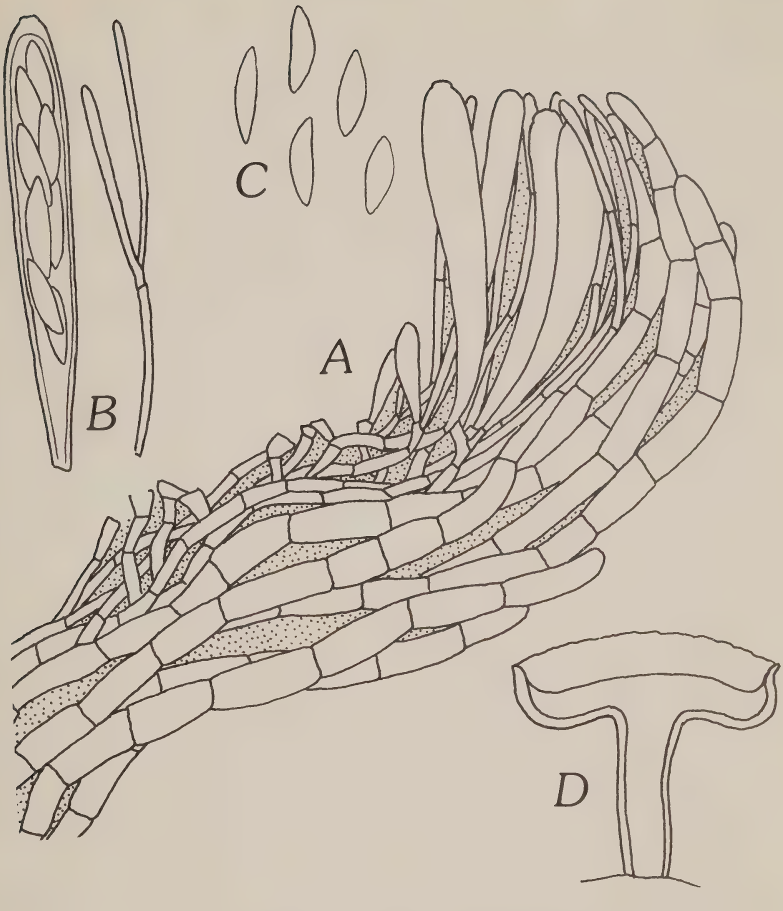


FIG. 13. *Poculum titubans*, lectotype ex PC, freehand drawings. A. Median longitudinal section of an apothecium through margin and upper portion of receptacle, stippling represents gelatinous matrix. B. An ascus with 8 ascospores and a paraphysis. C. 5 ascospores drawn after discharge from the ascus. D. Cross section of whole apothecium. A-C x 1,000; D x ca 50.

Microconidial state — Unknown.

Apothecial morphology — Apothecia solitary to gregarious, arising in association with black lines on the host, stipitate, ca 1mm in diam, ca 0.5-.75mm high, disc when fresh cupulate, drying with the margin curling over the hymenium, rehydrating flat to slightly convex, when fresh "rojo amoratado o fuliginoso," hymenium drying brown, rehydrating lighter; receptacle when dry and rehydrated concolorous with hymenium or slightly lighter; stipe when dry concolorous above with the lower portion of the receptacle, black at the base.

Apothecial anatomy — Asci 8-spored, 50-60x8-10(-12)μm, presence or absence of croziers not determined, broadly clavate to cylindric-clavate, tapering toward the base, wall 1-2μm thick, enlarged at the rounded apex and there 3-4μm thick; pore reaction in Melzer's Reagent not determined. Ascospores (9-)11-13x3-4μm, obliquely uniseriate to irregularly biseriate, hyaline, smooth, aseptate, ellipsoid, subfusoid, occasionally torpedo shaped, ends generally slightly pointed, in outline generally equilateral and frequently flattened on one surface, occasionally slightly curved, anterior end generally broader than posterior; guttules present, varying in shape and size, generally arranged in a single line occupying the majority of each ascospore and individually separated by narrow bands of cytoplasm. Paraphyses present, details obscured due to preservation of apothecium. Subhymenium not a distinct layer. Medullary excipulum poorly developed in the center of the receptacle and in the flanks, well differentiated from the ectal excipulum, non-refractive, lightly to intensely pigmented brown, consisting of septate, tightly compact, probably branching, parallel to interwoven hyphae 1-3μm wide, the walls thin, brown and generally lightly to coarsely roughened. Ectal excipulum: inner ectal excipulum not a distinct layer. Outer ectal excipulum highly refractive, gelatized, entire layer hyaline or with the gelatinous matrix pigmented yellow-brown, ca 25 μm wide towards the margin and to ca 25μm wide towards the stipe, consisting of long and narrow or brick-shaped cells extending parallel to each other (or slightly interweaving) and at low to high angles to the surface of the apothecium. Hairs and outer covering layer absent. Margin well developed, narrower above, broader below, entire zone light brown to more intensely pigmented towards the asci, constructed similarly to the apothecial flank below, the individual cells slightly smaller, the apically free cells unmodified. Stipe constructed somewhat differently from the receptacle, lacking the refractive, glassy appearance of the receptacle, to the outside a zone of hyaline to lightly pigmented textura prismatica grading to the inside to a zone of longer and narrower, intensely pigmented hyphae, in the central core the hyphae remaining parallel or slightly interwoven, the individual hyphae with walls thin to slightly thickened, smooth or more commonly roughened towards the center; at the base, rind cells observed. Hairs absent.

Habitat: On leaves.

Etymology of the specific epithet: relevance to the fungus uncertain.

Lectotype: Helotium titubans - Chile, ad folia, Gay (PC).

Illustration: Gay, Flora Chileana Atlas Botanica Cryptogamia pl. 8, fig. 6. 1850. (not seen).

NOTES. Helotium titubans was originally described by Montagne (1853) as occurring on leaves in Chile, and was reported from Cape Horn by Hariot (1889). In the original description no holotype specimen cited, and there are three specimens deposited at PC under this name. One collection was made by Hariot and serves as the voucher specimen for the Cape Horn report and is, thus, not eligible as a possible type. The remaining two were both collected in Chile by Gay and represent the same species. I have annotated them with two of my own numbers 3085 and 3164. I select, herewith the specimen deposited at PC bearing my number 3085 as the lectotype specimen for *Helotium titubans*. It agrees in all regards with the protologue, is certainly one of the specimens used in the original description, and has more apothecia than specimen 3164. Dennis (1964) transferred the species to *Hymenoscyphus* and commented "*H. titubans* should possibly be referred elsewhere..." In view of the fact that the fungus produces a substratal stroma, the species doubtless belongs in the Sclerotiniaceae; and because of the presence of a gelatinous matrix in the ectal excipulum, it should be placed in the genus *Poculum*. I herewith propose the formal transfer:

Poculum titubans (Montagne in Gay) Dumont, comb. nov.

Basionym: Helotium titubans Montagne in Gay, Historia Física y Política Chile, Botánica 7: 408. 1853.

Poculum titubans is most easily distinguished from other foliicolous species of *Poculum* by the presence of large, brick-shaped cells in the ectal excipulum, and by multiguttulate spores measuring (9-)11-13x3-4µm. The pigmented, sterile tissue is further characteristic of the species. I have examined the Hariot collection upon which the report of the species from Cape Horn was made, and I conclude that it is a very different species, still unknown to me.

68. *Helotium uleanum* (Rehm) Dennis, Kew Bull. 1954: 323. 1954.

≡ *Phialea uleana* Rehm, Hedwigia 39: 93. 1900.

NOTES. *Phialea uleana* was described from Brazil on leaves. Dennis (1954) transferred it to *Helotium* and later to *Ciboriopsis* (Dennis, 1962). Dumont (1976) placed the species into synonymy with *Helotium lentum* Berkeley & Broome, and transferred that species to *Moellerodiscus*, a decision which I still accept.

69. *Helotium umbilicatum* (Le Gal) Dennis, Kew Bull. 1954: 326. 1954. FIG. 14.

≡ *Pachydisca umbilicata* Le Gal, Rev. Mycol. (Paris) 3: 133. 1938.

Apothecial morphology — Apothecia variable, gregarious, substipitate to turbinate, to ca 5mm broad and to ca 3mm high, when fresh disc concave, umbilicate, margin wavy, drying slightly cupulate to flat, rehydrating flat to slightly concave. Hymenium when fresh yellow to cream, drying ochraceous, orange, rehydrating lighter; margin when fresh, dry, and rehydrated concolorous with the hymenium; receptacle concolorous with hymenium or slightly lighter, occasionally appearing dirty white due to "hairs" when fresh, dry, and rehydrated; stipe generally off-white to dull yellow when fresh, dry, and rehydrated.

Apothecial anatomy — Asci 8-spored, (90-)100-120(-130)x(7-)8-9(-10)µm, possibly produced from small croziers, long cylindric-clavate, gradually tapering to the base and there becoming slightly expanded to form a small foot, wall ca 1µm thick, enlarged at the subtruncate, rounded to subpapillate apex and there 3-4µm thick; pore J+, the walls stained very light blue in Melzer's Reagent. Ascospores (13-)15-18(-20)x(3-)4-5µm, generally biseriate throughout, less commonly biseriate above and uniseriate below

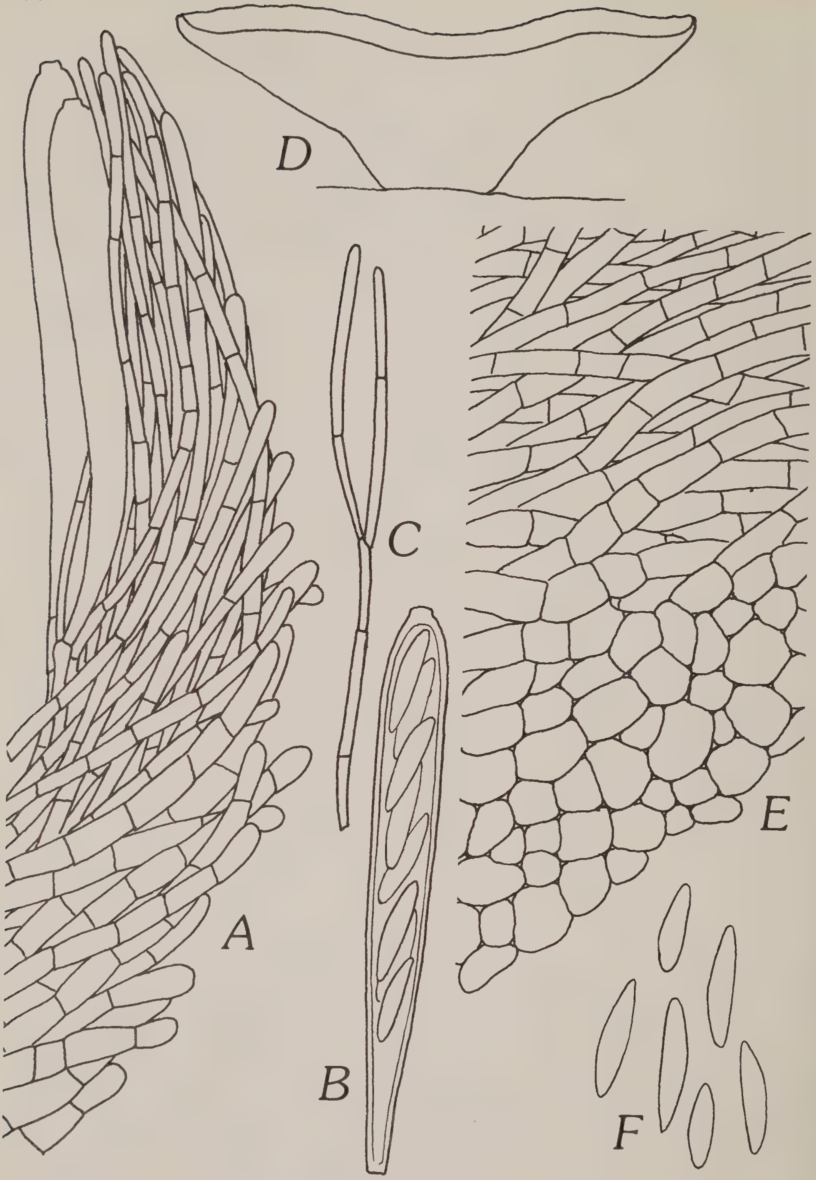


FIG. 14. *Hymenoscyphus umbilicatus*, lectotype ex PC, freehand drawings. A. Median longitudinal section of an apothecium through margin. B. An ascus with 8 ascospores. C. A paraphysis. D. Habit sketch of an apothecium on the substrate. A-C x 1,000; D x ca 50.

to irregularly uniseriate, hyaline, smooth, at first aseptate, becoming 1-septate after discharge or rarely while in the ascus, ellipsoid to fusoid, anterior end frequently pointed, posterior end rounded, in outline inequilateral, frequently flattened on one side or occasionally curved, anterior end frequently narrower than posterior end; guttules present, spherical to irregular, 2-3, large and also with smaller associated ones. Paraphyses equal to or slightly exceeding the asci, internally hyaline or possibly with contents staining golden yellow in Melzer's Reagent, branching towards the base of the asci, septate, filiform, not noticeably expanded at the apex and there 2-3µm wide, the walls thin, smooth and hyaline. Subhymenium well developed, not well differentiated from the medullary excipulum, hyaline, in the center to ca 60µm wide, consisting of hyphae generally very tightly interwoven and somewhat vertically oriented beneath the base of the asci or extending more or less parallel to the base of the asci towards the hyphae of the medullary excipulum, the individual hyphae 1-2µm wide, the walls thin, hyaline, and smooth. Medullary excipulum well developed, non-refractive, consisting of septate, branched, loosely interwoven hyphae 3-4(-5)µm wide, the walls thin, hyaline, and smooth. Ectal excipulum: inner ectal excipulum absent. Outer ectal excipulum towards the stipe composed of globose, angular to irregularly shaped cells, these cells becoming replaced by a poorly developed textura prismatica at first extending perpendicularly to the surface of the apothecium, the hyphae then extending at high angles to the surface and becoming progressively less so until the hyphae lie parallel to the surface of the apothecium towards the margin; individual brick-shaped cells towards the margin 8-12x3-4µm and the globose to irregular cells toward the stipe to ca 12µm wide at their broadest point; the walls thin or slightly thickened, hyaline and smooth. Outer covering layer absent. Hairs absent, but the apically free cells of the hyphae on the outer surface of the apothecium cylindric, clavate, or subcapitate, generally less than 15 µm long, 2-3(-4)µm wide, at the base septum, 3-8µm wide at the apex, simple, occasionally 1-septate, the walls thin, hyaline, smooth or rarely slightly roughened. Margin constructed of small brick-shaped hyphae as in the upper portion of the flanks, apical cells as in the flanks. Stipe constructed similarly to the lower portion of the flanks, at approximately midpoint and to the outside a zone of globose to irregular cells, in the center composed of parallel and interwoven hyphae without apparent organization. Hairs as on the flanks.

Habitat: Wood and acorns of *Quercus* sp. and wood of undetermined species.

Etymology of the specific epithet: refers to the umbilicate shape of the apothecium in fresh condition.

Holotype not designated in original description. The original description of *Pachydisca umbilicata* appears to have been based on more than one collection, and I designate herewith the following specimen as the lectotype specimen of the species as it appears to have been one of the collections cited in the original description and agrees with the protologue: France, Yerres, sur/souche de *Quercus* et cupule de gland, Jul 1937 (collector not cited) (ex PC).

Illustrations: Le Gal, Rev. Mycol. (Paris) 3: 133, fig. 3; 135, fig. 4. 1938.

Additional specimen examined: Jamaica, north side of Newhaven Gap, Blue

Mts., on wood, 26 Dec 1949, R. W. G. Dennis, s.n. (ex K).

NOTES. *Pachydisca umbilicata* was originally described from France as occurring on wood and acorns of *Quercus*. Dennis (1954) reported the species from Jamaica and transferred it to *Helotium* and later (Dennis, 1971) transferred it to *Phaeohelotium*. I have compared the type (designated here) with the Dennis collection and conclude that they represent the same species. I have, however, noted considerable variation between the two which may, in part, be due to the respective age of each specimen when collected. The Le Gal type is apparently slightly overmature with the majority of the ascospores discharged and adhering to the surface of the tips of the asci; the Dennis collection appears to be somewhat immature.

In the Le Gal type, the hyphae of the ectal excipulum extend at a very high angle to the surface of the apothecium, terminating in short hyphal protrusions, which gives the apothecium a downy appearance. In the Dennis collection, the hyphae also extend at a very high angle to the surface, but the apical cells are elongated and become easily detached from the outer surface and appear hair-like. The ascospores of the two collections are similar, those of the Le Gal type become occasionally septate, while I have not observed septate ascospores in the Dennis collection. Dennis (1954) and Le Gal both indicate that the ectal excipulum is composed of brick-shaped cells, but Dennis (1971) placed the species into *Phaeohelotium* indicating that the sterile tissue is composed of thin walled globose cells. I agree with Dennis (1971) that, at least in part, the lower portion of the ectal excipulum is composed of globose to angular cells, but they are replaced in the upper portion by a well developed textura prismatica.

The structure of *Helotium pachydiscum* is very similar to that of *Hymenoscyphus epiphyllus* sensu authors. In *H. epiphyllus* the stipe is composed mainly of globose to angular cells, which at the juncture of the stipe and substipe become replaced by textura prismatica extending at high then low angles to the surface of the apothecium, much in the same way that the tissue is formed in *H. pachydiscum*. In *H. pachydiscum*, however, the globose to irregular cells extend well into the flanks before being replaced by the parallel hyphae, whereas in the comparable structure in *Hymenoscyphus epiphyllus* the globose cells generally do not extend much beyond the juncture of the stipe and receptacle.

In view of the similarity of the sterile tissues of *Hymenoscyphus epiphyllus* and *Helotium pachydiscum*, I conclude that they both belong in the same genus. It is still premature to erect a new genus for *Hymenoscyphus epiphyllus* and allies, since the remaining species of *Helotium/Hymenoscyphus* should be studied and interpreted. The evidence now is that species such as *Hymenoscyphus caudatus* and its allies as defined by Dumont & Carpenter (1981) are fundamentally different in structure from the *H. epiphyllus* group. I make the formal transfer of *Pachydisca umbilicata* to *Hymenoscyphus* as follows:

Hymenoscyphus umbilicatus (Le Gal) Dumont, comb. nov.

Basionym: Pachydisca umbilicata Le Gal, Rev. Mycol. (Paris) 3: 133. 1938.

70. *Helotium velhaense* (P. Hennings) Le Gal, Prod. Flore Mycol. Madagascar 4: 350. 1953.

≡ *Ciboria velhaensis* P. Hennings, Hedwigia 41: 28. 1902.
≡ *Hymenoscyphus velhaensis* (P. Hennings) Dennis, Persoonia 3: 74. 1964.

NOTES. *Helotium velhaense* was originally described from Brazil as occurring on wood and as Le Gal (1953) pointed out, type material cannot now be located.

From the original description it is impossible to determine exactly what Hennings had; however, it is possible that it is either *Hymenoscyphus lasiopodius* or *H. sclerogenus*. Both have small waxy, yellow, fruitbodies occurring on wood and ascospores which would fall into the range given by Hennings, 23-33x5-7μm.

As Dumont & Carpenter (1981) have pointed out, *H. lasiopodius* is almost always 3-septate, while *H. sclerogenus* is only rarely 1-septate. Hennings reported his species to be at first 1-septate and later 3-septate, and he further notes that the stipe is pruinose, the character from which *H. lasiopodius* derives its name!

Dennis (1964) has transferred *Ciboria velhaensis* to *Hymenoscyphus*, an act with which I am not in full agreement. Rather, it is probably that it is a taxonomic synonym of *H. lasiopodius* or *H. sclerogenus*, more likely the former. A final decision can be made only after a neotype is designated or an authentic specimen located.

71. *Helotium vile* Rick, Brotéria, Sér. Bot. 25: 114. 1931.

NOTES. *Helotium vile* was described from south Brazil on leaves. Dennis (1960a) reported having examined the type of *H. vile* and indicated that it was like *Helotium caracassense* Dennis. He noted that the two species were similar in habit and structure, but differed in color; he chose not to place his species into synonymy with the Rick species. Dennis (1964) transferred *H. caracassense* to *Hymenoscyphus*, but did not treat the older *Helotium vile*. I have examined the Dennis and Rick types and conclude that they are the same and place them both into synonymy with *Lambertella microspora* (Seaver) Dumont. See Dumont (1971, 1974a) for full description, illustration, and discussion of this species under the name *Lambertella pallidispora*.

Presumed holotype: Helotium vile - Brazil, São Leopoldo, on leaves, 1929, J. Rick (ex PACA 13216).

72. *Helotium viridi-flavum* Rick, Brotéria, Sér. Bot. 25: 115. 1931.

NOTES. *Helotium viridi-flavum* was described on wood from Brazil with ascocarps 3-4mm wide and 2-4mm high, "Viridi-flavum," and with ascospores 22-25x3-5µm. As Dennis (1960a) pointed out, the type specimen from the Rick Herbarium does not contain any recognizable apothecia. Without type or authentic material, I am uncertain as to where the species should be placed, and cannot treat the species further here.

Acknowledgements

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NORTH AMERICAN WOOD-ROTTING FUNGI THAT CAUSE BROWN ROTS[1]

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SUMMARY

One hundred and thirteen species of North American wood-rotting Basidiomycetes are reported to cause brown rots. The majority of these, 71, are in the Polyporaceae. Others are distributed in various families of the Tremellales, Aphyllophorales, and Agaricales. Most occur primarily on conifers and play an essential role in maintaining the coniferous forest ecosystem. A synopsis and a check list give information on substrata, distribution, and sexuality and references to literature on cultural studies and other aspects of the brown rot fungi. New combinations proposed are *Crustoderma resinosum, Fomitopsis meliae,* and *Laetiporus persicinus*.

Decay of wood by wood-rotting fungi is generally considered to be of two major types commonly referred to as white rots and brown rots. The white rot fungi are able to degrade both of the major components of woody cell walls, cellulose and lignin. They also bleach the wood and leave a white to pale colored residue that has a spongy, stringy or laminated structure. Most produce extracellular phenol oxidases and generally give positive oxidase tests on gallic and tannic acid media (52, 138) and with gum guaiac (73, 139) or syringaldazine (80) reagents. Some wood-rotting fungi are unable to degrade lignin and selectively remove cellulose and other polysaccharides from wood. These brown-rot fungi leave an amorphous, brown, crumbly residue that is composed largely of lignin. They do not produce extracellular phenol oxidases and generally give negative oxidase tests on gallic and tannic acid media and with gum guaiac and syringaldazine reagents.

Although brown-rot fungi are able to degrade cellulose rapidly in natural wood, they are generally unable to decompose pure cellulose. Exceptions to this are 15 members of the Coniophoraceae in the genera *Coniophora*, *Coniophorella*, *Leucogyrophana*, and *Serpula,* as well as *Paxillus panuoides* and *Hygrophoropsis aurantiacus* of the Paxillaceae. All 17 of these fungi gave positive tests for cellulase when grown on agar media containing pure cellulose (135, 136). As pointed out by Nilsson and Ginns (136), *P. panuoides* and *H. aurantiacus* have basidial, hyphal, and spore characters that indicate a close relationship to species in the Coniophoraceae.

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North American wood-rotting fungi that cause brown rots have been estimated to comprise only about 6 per cent of the total number (70). My previous estimate was that only about 106 species out of 1669 were brown-rot fungi. The number of brown-rot fungi recognized in this synopsis is slightly higher, 113. More species of wood-rotting fungi including some that cause brown rots will undoubtedly be discovered in North America in the future but the percentage of known brown-rot fungi will probably remain about the same.

About 70 per cent of North American brown-rot fungi are in the Polyporaceae. The other 30 per cent are distributed among several families in the orders Aphyllophorales, Agaricales, and Tremellales. Apparently the brown-rot type of enzyme system has evolved independently in a number of groups that do not show close relationships as indicated by comparative morphology. The question arises as to why the Polyporaceae contains such a high percentage of the brown-rot fungi. The answer to this question should provide an important clue to the phylogeny of polypores. For one thing, the Polyporaceae is one of the largest families containing wood-rotting fungi. North American polypores in monographs by Overholts (142) and Lowe (110) number approximately 368, and 71, or 19 per cent, cause brown rots. The total includes the polyporoid Hymenochaetaceae, all of which are white rot fungi. If an estimated 50 species of *Phellinus* and *Inonotus* are removed from this total, the percentage of brown-rot fungi in the Polyporaceae is 22.7 per cent.

Substratum relationships of brown-rot fungi are summarized in Table 1. It has been pointed out (70, 140) that brown-rot fungi are primarily associated with conifers. Most occur primarily on dead conifer wood including dead standing and fallen trees, stumps, logging slash, other dead wood on the ground, and wood in service. Some of these also occur less commonly on hardwoods, particularly aspen, an associate of conifers in coniferous forest areas (107). A small number occur primarily on dead hardwoods. Some brown-rot fungi decay heartwood in living trees. Of these, the ones that cause heartrots in species of the Cupressaceae are the most host-specific. *Tyromyces amarus* is restricted to incense cedar (28, 170), *Poria sequoiae* to redwood (99, 100), *Poria sericeomollis* to western red cedar (33), *Daedalea juniperina* to junipers (72), and *Tyromyces basilaris* to Monterey and Arizona cypresses (3). *Veluticeps berkeleyi* has been reported to cause heart rot only in hard pines (87), *Lentinus kauffmanii* only in Sitka spruce (25), and *Tyromyces balsameus* only in balsam fir (98). Most of the brown-rot fungi that decay heartwood in species of the Pinaceae are known to occur on species from several genera of that family. These include *Fomitopsis officinalis*, *Phaeolus schweinitzii*, *Sparassis crispa*, and *Laetiporus sulphureus*. A few brown-rot fungi cause heart rots in hardwoods only. Examples of this group are *Tyromyces spraguei*, *Coprinus atramentarius*, *Fomitopsis meliae*, and *Daedalea quercina*. Brown-rot fungi that decay heartwood in both conifers and hardwoods include *Fomitopsis pinicola*, *Laetiporus sulphureus*, *Poria cocos*, and *Sparassis herbstii*.

The most important brown-rot fungus in terms of losses in volume of merchantable timber is probably *Phaeolus schweinitzii*. Gross volume losses due to *P. schweinitzii* are much less than caused by *Phellinus pini* in Douglas fir (29, 31). However, since practically all of the volume loss is in the high-grade butt log, the actual economic loss is higher than a comparable volume loss in other logs would entail.

The sexuality of the majority of the brown-rot fungi remains undetermined. The ones that have been studied are predominately heterothallic, and bipolar. However, tetrapolar mating systems have been reported in a number of genera including *Veluticeps*, *Dacryobolus*, *Serpula*, *Amylocystis*, and *Tyromyces*. Indeed, the recent work of David (47) indicates that most species of *Tyromyces* are tetrapolar. Homothallism is also known in the brown-rot fungi, specifically in *Coniophora puteana* (141) and *Coriolellus malicola* (148). Most heterothallic brown-rot fungi have clamp connections on dikaryotic generative hyphae, and their sexuality could probably be readily determined. Species of brown-rot fungi lacking clamps occur primarily in the genera *Coniophora*, *Coniophorella*, *Phaeolus*, and *Laetiporus*. Multiple clamps, a character commonly associated with homothallism, are found in *Coniophora puteana* and *Amylosporus graminicola*. *Coniophora puteana* is homothallic and the sexuality of *A. graminicola* has not been determined.

Brown-rot fungi have an essential role in the functioning of coniferous forest ecosystems. Brown-rot residues are extremely stable and may persist in the upper layers of forest soils for 500 years or more (102). They may constitute up to 26% of the total soil volume in the upper 1 foot of soil and amount to over 40,000 lbs per acre dry weight (125). These large volumes of brown cubical rot residues have several attributes that enhance the establishment and development of conifers and other plants. The gradual decay process plays a key role in recycling nutrients and keeping them in the forest ecosystem (23). Decay fungi in themselves may serve as nutrient sinks and minimize loss of mineral nutrients by leaching. A number of studies have shown that continuous removal of wood residues results in a reduction in site quality and a reduction in plant growth (83). Soils with a high content of brown-rot residues have an increased water holding capacity and a higher cation exchange capacity (83, 95, 96). Brown-rot residues in coniferous forest soils are a major site of ectomycorrhizal root development (83, 84, 85, 86, 95, 96, 102) particularly during the dryer periods of the growing season. These residues are also a site of nitrogen fixation both in or on the soil (83, 84, 85, 94, 95, 96, 102, 103).

These ecological functions of brown-rot fungi are more than important; they are essential to the perpetuation of our great North American coniferous forest ecosystems (85). Wood residues in our coniferous forests represent a critical natural resource that must be managed wisely and maintained at an adequate level to insure continuous productivity and perpetuation of all of the desirable attributes of our coniferous forest ecosystems for future generations. Rapidly developing demands on wood residues as an energy source require that management programs to protect their essential ecological function be instituted as soon as possible.

In Table 1 the distribution by states and provinces is listed by regions and indicated by abbreviation as follows:

Southeast and Gulf Coast

AL- Alabama; AR- Arkansas; DC- District of Columbia; FL- Florida; GA- Georgia; LA- Louisiana; MS- Mississippi; NC- North Carolina; OK- Oklahoma; SC- South Carolina; TN- Tennessee; TX- Texas; VA- Virginia

Midwest

IL- Illinois; IN- Indiana; IA- Iowa; KS- Kansas; KY- Kentucky; MI- Michigan; MN- Minnesota; MO- Missouri; NB- Nebraska; ND- North Dakota; OH- Ohio; SD- South Dakota; WI- Wisconsin

Northeast

CT- Connecticut; DE- Delaware; ME- Maine; MD- Maryland; MA- Massachusetts; NH- New Hampshire; NJ- New Jersey; NY- New York; PA- Pennsylvania; RI- Rhode Island; VT- Vermont; WV- West Virginia

West

AK- Alaska; AZ- Arizona; CA- California; CO- Colorado; HI- Hawaii; ID- Idaho; MT- Montana; NV- Nevada; NM- New Mexico; OR- Oregon; UT- Utah; WA- Washington; WY- Wyoming

Canada

AT- Alberta; BC- British Columbia; MB- Manitoba; NB- New Brunswick; NF- Newfoundland; NWT- Northwest Territories; NS- Nova Scotia; OT- Ontario; PEI- Prince Edward Island; QB- Quebec; SK- Saskatchewan; YT- Yukon Territory

Symbols indicating sexuality are as follows:
0- Homothallic; H- Heterothallic, type of mating system unknown; II- Heterothallic and bipolar; IV- Heterothallic and tetrapolar; ND- No data.

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SYNOPSIS OF NORTH AMERICAN WOOD-ROTTING FUNGI THAT CAUSE BROWN ROTS

Key to Orders of Basidiomycetes that contain brown-rot fungi

1. Basidia septate . . . . TREMELLALES
1. Basidia not septate 2
    2. Hymenophore in form of radial lamellae; basidiocarps mostly fleshy, deteriorating readily after maturity . . . . AGARICALES
    2. Hymenophore smooth, hydnaceous, merulioid, in the form of united tubes or erect flattened branches; if lamellate, then basidiocarps tough, corky and not deteriorating rapidly . . . . APHYLLOPHORALES

TREMELLALES

One species in the genus *Helicobasidium* Pat. of the family Auriculariaceae is known to cause a brown rot.

Helicobasidium corticioides Bandoni. Basidiocarps effused; hymenial surface white to cream colored; hyphae simple-septate; basidia usually 4-celled, slightly coiled or circinate; basidiospores broadly ellipsoid with a large, blunt apiculus, 14-22 x 6.5-12.5 µm.

APHYLLOPHORALES

Key to families of Aphyllophorales that contain brown-rot fungi

1. Basidiocarps with hymenophore in form of united or separate tubes 2
1. Basidiocarps not as above 3
    2. Tubes united . . . . POLYPORACEAE
    2. Tubes separate . . . . FISTULINACEAE
3. Basidiocarps much branched with hymenium on surface of erect, anastomosing, petal-like lobes . . . . . SPARASSIDACEAE
3. Basidiocarps not as above 4
    4. Basidiospores brown to yellowish, dextrinoid or not in Melzer's reagent . . . . CONIOPHORACEAE
    4. Basidiospores hyaline or faintly pigmented, negative, amyloid or dextrinoid in Melzer's reagent 5
5. Basidiocarps becoming effused-reflexed to sessile . . .STEREACEAE
5. Basidiocarps remaining completely resupinate. . . . CORTICIACEAE

Family CORTICIACEAE

Key to genera that contain brown-rot fungi

1. Hymenial surface smooth to tuberculate, basidiocarps resupinate 2
1. Hymenial surface merulioid, basidiocarps often reflexed . . . . *Pseudomerulius* Jülich

Pseudomerulius aureus (Fr.) Jülich. Basidiocarps small, not over a few cm wide; hyphae with clamps; cystidia lacking; basidia 15-17 x 3-3.5 µm; basidiospores cylindric, slightly curved, pale yellowish in KOH, negative in Melzer's reagent, 3.5-4.5 x 1.5-2 µm. (Syn.: *Merulius aureus* Fr.; *Plicatura aurea* (Fr.) Parm.)

2. Basidia small, 20-25 x 3-3.5 µm; basidiospores allantoid, 4.5-6 x 0.7-1.5 µm . . . . *Dacryobolus* Fr.
2. Basidia large, 30-100 m long and 5-7 µm wide; basidiospores cylindric to ellipsoid, over 3 µm wide 3

3. Basidia clavate, 30-80 x 5-9 µm; basidiospores cylindric to broadly ellipsoid, 7-12 x 3-7 µm. . . . . . .*Crustoderma* Parm.
3. Basidia long and slender, up to 100 µm long, 5-6 µm wide; basidiospores cylindric, 12-18 µm long . . . . *Chaetoderma* Parm.

Chaetoderma luna (Rom.) Parm. Basidiocarps white to cream colored, developing in small, often confluent patches, pilose under a 10 x lens; hyphae with clamps; cystidia very abundant, cylindric to narrowly clavate, thick-walled, wall thinning out at apex; basidia narrowly clavate; basidiospores hyaline, negative in Melzer's reagent. (Syn.: *Peniophora luna* Rom.)

Key to species of *Crustoderma*

1. Basidiospores cylindric to cylindric-ellipsoid, 8-12 x 3-4 µm; cystidia with walls moderately thickened at base

Crustoderma dryinum (Berk. et Curt.) Parm. Basidiocarps becoming extensively effused; hyphae with clamps; cystidia abundant, cylindric, thin- to slightly thick-walled, not incrusted, up to 160 µm long, 6-10 µm in diam; basidia 25-35 x 5-6 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-12 x 3-4 µm. (Syn.: *Peniophora dryina* (Berk. et Curt.) Rogers et Jacks.)

1. Basidiospores broadly ellipsoid, 7-9 x 4.5-5.5 µm; cystidia with walls strongly thickened at base

Crustoderma resinosum (Jacks. et Deard.) comb. nov. (basionym- *Peniophora resinosa* Jacks. et Deard., Can. J. Res., C, 27:147). 1949) Basidiocarps becoming widely effused, buff to reddish brown on drying, often resinous; hyphae with clamps; cystidia abundant, clavate, incrusted apically with resinous material; basidiospores hyaline, negative in Melzer's reagent.

Key to species of *Dacryobolus*

1. Hymenial surface smooth; cystidia thick-walled

Dacryobolus karstenii (Bres.) Oberw. ex Parm. Basidiocarps becoming extensively effused; hymenial surface cream colored to pale buff, cracking extensively on drying; hyphae thin-walled, with clamps, or thick-walled and aseptate; basidiospores 4.5-6 x 1-1.5 µm; fresh basidiocarps and rot with a sweet anise odor. (Syn.: *Peniophora crassa* Burt)

1. Hymenial surface papillate with amber colored droplets at the apices of the papillae; cystidia thin-walled

Dacryobolus sudans (Fr.) Fr. Basidiocarps effused up to several cm; hymenial surface cream colored to ochraceous-buff; hyphae thin- to thick-walled, with clamps; cystidia with clamps or simple septa, clustered at apices of papillae; basidiospores 4-5.5 x 0.7-1 µm. (Syn.: *Odontia sudans* (Fr.) Bres.)

Family CONIOPHORACEAE

Key to genera

1. Hymenophore smooth or tuberculate 2
1. Hymenophore irregularly folded or toothed 3
   2. Cystidia absent, or if present, small and aseptate . . . . *Coniophora* DC. ex Mérat
   2. Large, septate cystidia abundant . . . . *Coniophorella* Karst.

Coniophorella olivacea (Fr.) Karst. Basidiocarps resupinate, adnate; hymenial surface smooth, olivaceous, strongly cystidiate under 10 x lens; hyphae simple-septate; cystidia abundant, septate, coarsely incrusted, projecting to 140 µm, 9-12 µm in diam; basidiospores cylindric-ellipsoid, strongly dextrinoid in Melzer's reagent, 8-13 x 4-6 µm.

3. Basidiospores pigmented, pale, dark yellowish-brown in KOH solution, dextrinoid in Melzer's reagent. . . *Serpula* S. F. Gray
3. Basidiospores hyaline in KOH, dextrinoid in Melzer's reagent . . . . *Leucogyrophana* Pouz.

Key to species of *Coniophora*

1. Basidiospores ovoid to ellipsoid, 10-18 µm long 2
1. Basidiospores fusiform, 16-24 µm long

Coniophora fusispora (Cke. et Ell.) Cke. Basidiocarps arid, separable; hymenial surface dark olivaceous brown, smooth; margin cream colored; subiculum soft, cream colored; hyphae simple-septate; cystidia lacking; basidiospores dextrinoid in Melzer's reagent.

   2. Basidiocarps thin, arid; hyphae simple-septate or with very rare single clamps 3
   2. Basidiocarps becoming thick, fleshy; some hyphae with single, double or multiple clamps

Coniophora puteana (Schum, ex Fr.) Karst. Basidiocarps resupinate, adnate; hymenial surface olive brown; margin cream colored, floccose; hyphae up to 14 µm in diam; cystidia lacking; basidia up to 110 µm long; basidiospores strongly dextrinoid in Melzer's reagent, 11-16 x 7-9 µm. (Syn.: *Coniophora cerebella* Pers.)

3. Basidiospores 14-18 x 5.5-8 µm; basidiocarps not rhizomorphic, adnate 4
3. Basidiospores 7.5-14 x 5.5-8 µm; basidiocarps fragile, rhizomorphic, easily separated from substratum

Coniophora eremophila Linds. et Gilbn. Basidiocarps resupinate; hymenial surface smooth light brownish olive; subiculum white, floccose; rhizomorphs white; cystidia lacking; basidia 50-55 x 6-8 µm; basidiospores strongly dextrinoid in Melzer's reagent, 7.5-14 x 5-9 µm.

   4. Subicular hyphae incrusted

Coniophora suffocata (Pk.) Massee. Basidiocarps resupinate, adnate; hymenial surface smooth, olivaceous to umber; margin usually whitish; basidia utriform; cystidia lacking; basidiospores strongly dextrinoid, 10-14 x 6-7 µm.

4. Subicular hyphae not incrusted

Coniophora arida (Fr.) Karst. Basidiocarps resupinate; hymenial surface smooth, pale brown to olive brown, margin yellowish brown to whitish; basidia utriform, up to 80 µm long; cystidia lacking; basidiospores strongly dextrinoid in Melzer's reagent, 10-18 x 7-8 µm.

Key to species of *Leucogyrophana*

1. Hymenophore smooth, grandinioid, or merulioid. 2
1. Hymenophore becoming strongly hydnaceous

Leucogyrophana pinastri (Fr.) Ginns et Weres. Basidiocarps resupinate, readily separable; hymenial surface olive-brown to yellowish brown; hyphae with clamps; basidia 18-30 x 6-7 µm; basidiospores ellipsoid, dextrinoid in Melzer's reagent, 4.5-7 x 3-5 µm. (Syn.: *Merulius pinastri* (Fr.) Burt; *Serpula pinastri* (Fr.) W. B. Cooke)

2. Hymenial surface merulioid 3
2. Hymenial surface smooth to grandinioid, mustard colored to olive-green

Leucogyrophana olivascens (Berk. et Curt.) Ginns et Weres. Basidiocarps fragile; hymenial layer pelliculose; subiculum white, floccose; hyphae with clamps; basidia 20-25 x 5-5.5 µm; cystidia hyphoid, up to 60 µm long, 3-4 µm in diam; basidiospores ellipsoid, dextrinoid in Melzer's reagent, 4-6.5 x 3-4 µm. (Syn.: *Coniophora olivascens* (Berk. et Curt.) Massee)

3. Basidiospores negative in Melzer's reagent. 4
3. Basidiospores dextrinoid in Melzer's reagent. 5
   4. Basidiospores 5-7 x 3.5-4.5 µm

Leucogyrophana pulverulenta (Fr.) Ginns. Basidiocarps effused, fleshy; hymenial surface raduloid to merulioid, drying dark brown; margin and subiculum cream colored, soft; hyphae with clamps; basidiospores ellipsoid, yellow.

4. Basidiospores 4-5 x 2.5-3 µm

Leucogyrophana sororia (Burt) Ginns. Basidiocarps effused, separable; hymenial surface merulioid, pale orange; subiculum white to cream colored, hyphae with clamps; basidiospores ellipsoid, pale yellow. (Syn.: *Coniophora sororia* Burt)

5. Basidiospores 4.5-9 µm long. 6
5. Basidiospores 3-4.5 µm long

Leucogyrophana montana (Burt) Domanski. Basidiocarps soft, fragile, readily separable; hymenial surface shallowly merulioid, purplish pink when fresh, drying dark purplish brown; margin floccose, ochraceous; hyphae with clamps; basidiospores ovoid to ellipsoid, pale yellow, 4-4.5 x 2.5-3 µm. (Syn.: *Coniophora montana* Burt)

6. Hymenial surface pinkish orange; basidiocarp thick, fleshy. 7
6. Hymenial surface yellow; basidiocarp thin, delicate, pelliculose

Leucogyrophana romellii Ginns. Basidiocarps becoming widely effused; hymenial surface smooth to shallowly merulioid; hyphae with clamps; basidia 25-28 x 5-7 µm; basidiospores ellipsoid, pale yellowish, 4.5-6 x 3.5-4.5 µm.

7. Basidiospores with an apical germ pore

Leucogyrophana arizonica Ginns. Basidiocarps becoming widely effused, soft, separable; hymenial surface strongly merulioid, drying cream-buff to dark reddish brown; hyphae with clamps; basidia 27-30 x 7-8 µm; basidiospores ellipsoid, pale yellow, strongly dextrinoid in Melzer's reagent, 7-9 x 4-5 µm.

7. Basidiospores without an apical germ pore

Leucogyrophana mollusca (Fr.) Pouz. Basidiocarps resupinate, rarely effused-reflexed; easily separable; hymenial surface strongly merulioid, orange to brownish orange; margin and subiculum tissue white to cream colored, soft; hyphae with clamps. (Syn.: *Merulius molluscus* Fr.)

Key to species of *Serpula*

1. Basidiocarps thick, fleshy, becoming effused-reflexed

Serpula lacrimans (Wulf. ex Fr.) S. F. Gray. Basidiocarps often extensive; hymenial surface rusty brown, with deep folds, porose to strongly dentate; hyphae with clamps; cystidia lacking; basidiospores strongly dextrinoid in Melzer's reagent, 9-10.5 x 5.5-6 µm. (Syn.: *Merulius lacrimans* Wulf. ex Fr.)

1. Basidiocarps thin delicate, completely effused

Serpula himantioides (Fr.) Bond. Basidiocarps separable, usually associated with pink or pale purplish, floccose mycelium; hymenial surface pale to dark brown, with shallow folds; hyphae with clamps; cystidia lacking; basidiospores narrowly ellipsoid, strongly dextrinoid in Melzer's reagent, 9-14 x 5-6 µm. (Syn.: *Merulius himantioides* Fr.)

Family FISTULINACEAE

Single genus - *Fistulina* Bull. ex Fr.

Fistulina hepatica Schaeff. ex Fr. Basidiocarps sessile or with a narrowed base; 10-30 cm wide; applanate; upper surface reddish orange to reddish brown; context soft, oozing a reddish juice;

tubes soft, 10-15 mm long; basidiospores ovoid, pale rusty brown in mass, negative in Melzer's reagent, 4-5.5 x 3-4 µm.

Family POLYPORACEAE

Key to genera containing brown-rot fungi

1. Basidiocarps stipitate, sessile, or effused-reflexed, sometimes resupinate at first 2
1. Basidiocarps resupinate at all stages of development . . . . *Poria* Pers. ex S. F. Gray
  2. Basidiocarps annual, rarely reviving a second year. 3
  2. Basidiocarps perennial, tubes typically stratified. . . . . *Fomitopsis* Karst.
3. Hymenophore in form of united tubes, tube mouths (pores) circular to angular or daedaloid 4
3. Hymenophore in form of radial lamellae . . . .*Gloeophyllum* Karst.
  4. Contextual and tramal hyphae simple-septate, clamps lacking 5
  4. Contextual and tramal generative hyphae with clamp connections, clamps at base of basidia 6
5. Contextual tissue and pileus surface brown or orange; large non-incrusted cystidia present . . . . *Phaeolus* (Pat.) Pat.
5. Contextual tissue white to pinkish buff; pileus surface orange or pinkish brown; cystidia lacking . . . . *Laetiporus* Murr.
  6. Generative hyphae with simple clamps; basidiospores not amyloid in Melzer's reagent. 7
  6. Generative hyphae with some double and multiple clamp connections; basidiospores amyloid in Melzer's reagent. . . . . *Amylosporus* Ryvarden

Amylosporus graminicola (Murr.) Ryvarden. Basidiocarps substipitate on ground to sessile on standing trees; drying light and fragile; upper surface white at first, becoming buff to pale brownish, finely tomentose; pores 2-4 per mm; context white when fresh, becoming buff to vinaceous brown, soft and fragile on drying; older specimens malvaceus; dimitic; generative hyphae thin-walled with some single, double, or multiple clamps; skeletal hyphae thick-walled, aseptate; gloeoplerous hyphae also present; cystidia lacking; basidiospores ellipsoid, hyaline, weakly to strongly amyloid in Melzer's reagent; smooth or with amyloid granules, 4.5-5.5 x 2.5-4 µm. (Syn.: *Tyromyces graminicola* Murr.)

7. Pores strongly daedaloid . . . . *Daedalea* Pers. ex Fr.
7. Pores circular to angular. 8
  8. Basidiocarps fibrous to corky when dried. 9
  8. Basidiocarps hard and bone-like on drying . . . .*Osteina* Donk

Osteina obducta (Berk.) Donk. Pileus circular, dimidiate or spathulate; upper surface pale buff to gray; pore surface cream colored to yellowish; basidiospores oblong ellipsoid, hyaline, negative in Melzer's reagent, 4-6 x 2-2.5 µm. (Syn.: *Polyporus osseus* Kalchbr.; *Polyporus zelleri* Murr.).

9. Basidiocarps sessile or effused-reflexed; mainly on conifers . 10
9. Basidiocarps laterally substipitate; virtually restricted to *Betula*. . . . . *Piptoporus* Karst.

Piptoporus betulinus (Fr.) Karst. Basidiocarps dimidiate, solitary; upper surface gray to pale buff, pelliculose; margin rounded, usually extending below pore surface; context white; tube layer easily separated when fresh; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric to allantoid, hyaline, negative in Melzer's reagent, 4.5-6 x 1.5-2 µm. (Syn.: *Polyporus betulinus* Fr.)

10. Hyphal system monomitic although some generative hyphae may become thick-walled 11
10. Hyphal system dimitic or trimitic with distinct thick-walled, aseptate skeletal hyphae 12
11. Contextual hyphae, tramal hyphae and cystidia, if present, not amyloid . . . . *Tyromyces* Karst.
11. Contextual hyphae, tramal hyphae, and cystidia amyloid, at least in part. . . . . *Amylocystis* Bond. et Sing.

Amylocystis lapponica (Rom.) Bond. et Sing. Basidiocarps sessile; becoming reddish brown on bruising or drying; upper surface often hispid; hyphae with clamps; cystidia thick-walled, frequently incrusted at apex; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 2.5-3.5 µm. (Syn.: *Polyporus lapponicus* Rom.)

12. Context and tramal tissue white to ochraceous, if brown then pores more or less hexagonal; fresh basidiocarps and rot not with an anise odor. . . . .*Coriolellus* Murr.
12. Context and tramal tissue brown; pores circular to elongated; fresh basidiocarps and rot with an anise odor. . . . . *Osmoporus* Sing.

Osmoporus odoratus (Wulf. ex Fr.) Sing. Basidiocarps sessile or effused-reflexed; upper surface rusty brown, strigose to tomentose or darkening and glabrous with agar; pore surface yellowish brown, pores circular to angular, 2-3 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia none; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-13 x 3.5-5 µm. (Syn.: *Trametes odorata* (Wulf. ex Fr.) Fr.; *Trametes americana* Overh.)

Key to species of *Coriolellus*

1. Context and pore surface distinctly brown. 2
1. Context and pore surface white to cream colored or pale buff. . 3
   2. Fruiting on charred conifer wood; pores hexagonal; basidiospores allantoid

Coriolellus carbonarius (Berk. et Curt.) Bond. Basidiocarps usually resupinate, sometimes effused-reflexed or sessile; pores 2-3 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores hyaline, negative in Melzer's reagent, 7-9 x 2.5-3 µm. (Syn.: *Trametes carbonaria* (Berk. et Curt.) Overh.)

   2. Fruiting on uncharred hardwoods; pores circular to angular; basidiospores cylindric

Coriolellus malicola (Berk. et Curt.) Murr. Basidiocarps effused-reflexed or sessile; pores 3-4 per mm; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores hyaline, negative in Melzer's reagent; 7-11.5 x 2.5-3.5 µm. (Syn.: *Trametes malicola* Berk. et Curt.)

3. Basidiocarps usually sessile or effused-reflexed. 4
3. Basidiocarps usually resupinate

Coriolellus serialis (Fr.) Murr. Basidiocarps white to cream colored; hyphal system trimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 2.5-4 µm. (Syn.: *Trametes serialis* Fr.; *Trametes alaskana* Baxter)

4. Basidiospores mostly more than 10 µm long 5
4. Basidiospores 7-10 µm long

Coriolellus variiformis (Pk.) Sarkar. Upper surface of basidiocarps reddish brown; pore surface white to cream colored; pores angular or elongated, 1-2 per mm; hyphal system trimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7-10 x 3-4 µm. (Syn.: *Trametes variiformis* Pk.)

5. Basidiospores 12-14 µm long; pores 1-3 mm in diam

Coriolellus heteromorphus (Fr.) Bond. et Sing. Upper surface of basidiocarps cream colored to ochraceous; pore surface ivory white; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 12-14 x 4-5 µm. (Syn.: *Trametes heteromorpha* (Fr.) Bres.)

5. Basidiospores 8-12 µm long; pores 1-2 per mm.

Coriolellus sepium (Berk.) Murr. Upper surface of basidiocarps cream colored to pale brownish; pore surface ivory white; hyphal system dimitic, generative hyphae with clamps; basidiospores cylindric, hyaline, negative in Melzer's reagent; 8-12 x 2.5-4 µm. (Syn.: *Trametes sepium* Berk.)

Key to species of *Daedalea*

1. Context tissue cream colored to ochraceous 2
1. Context tissue dark brown

Daedalea berkeleyi Sacc. Upper surface and pore surface of basidiocarps reddish brown; pores up to 2 mm in diam; dissepiments thick and entire; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7-8 x 2.5-3 µm.

2. Basidiocarps effused or narrowly reflexed; on *Juniperus* only

Daedalea juniperina Murr. Upper surface of basidiocarps pale buff to cinnamon buff; pore surface light buff; pores up to 2 mm in diam; dissepiments thick, entire; hyphal system dimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6.5-9 x 2.5-3.5 µm.

2. Basidiocarps sessile; on hardwoods, especially *Quercus*

Daedalea quercina L. ex Fr. Basidiocarps applanate to ungulate; upper surface pale buff and tomentose at first, becoming blackened and rimose with age; context light buff; pore surface pale buff, the pores up to 2 mm in diam; dissepiments thick and entire; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 5-6 x 2-3 µm.

Key to species of *Fomitopsis*

1. Context and pore surface rose colored. 2
1. Context and pore surface white to pale buff, not rose colored. .3
   2. Basidiocarps usually sessile, ungulate; basidiospores straight, 5-8 x 2-3 µm

Fomitopsis rosea (Alb. et Schw. ex Fr.) Karst. Upper surface of basidiocarps rose colored at first, becoming brown to blackish and rimose with age; hyphal system dimitic, generative hyphae with clamps; cystidia lacking, basidiospores cylindric, hyaline, negative in Melzer's reagent. (Syn.: *Fomes roseus* Alb. et Schw. ex Fr.)

2. Basidiocarps sessile to effused-reflexed, usually applanate, often imbricate; basidiospores curved, 5-8 x 1.5-2.5 µm

Fomitopsis cajanderi (Karst.) Kotl. et Pouz. Upper surface of basidiocarps pinkish brown, becoming blackish and rimose with age; hyphal system dimitic, generative hyphae with clamps; cystidia lacking; basidiospores allantoid, hyaline, negative in Melzer's reagent. (Syn.: *Fomes cajanderi* Karst.; *Fomes subroseus* (Weir) Overh.)

3. Context tough-corky; tissue not bitter. 4
3. Context chalky and crumbly; tissue bitter

Fomitopsis officinalis (Vill. ex Fr.) Bond. et Sing. Basidiocarps ungulate to columnar; upper surface white to light buff, becoming rimose; pores 4-5 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia lacking, basidiospores ovoid, hyaline, negative in Melzer's reagent, 4-7 x 3-3.5 µm. (Syn.: *Fomes officinalis* (Vill. ex Fr.) Faull)

4. Basidiocarps usually sessile, applanate to ungulate

Fomitopsis pinicola (Swartz ex Fr.) Karst. Basidiocarps usually sessile, applanate to ungulate; upper surface glabrous, brownish to black, often reddish and resinous at the margin; pores circular, 5-6 per mm; hyphal system dimitic, generative hyphae with clamps; cystidia hyphoid; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6.5-7.5 x 3-4 µm. (Syn.: *Fomes pinicola* (Sw. ex Fr.) Cke.)

4. Basidiocarps resupinate to effused-reflexed; on living hardwoods

Fomitopsis meliae (Underw.) comb. nov. (basionym = *Polyporus meliae* Underw., Torrey Bot. Club. Bull. 24:85. 1897). Basidiocarps sessile or effused-reflexed, often imbricate; upper surface whitish to pale brownish; pores 4-5 per mm; hyphal system dimitic; generative hyphae with clamps; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6-8 x 2-3 µm. (Syn.: *Fomes meliae* (Underw.) Murr.)

Key to species of *Gloeophyllum*

1. Upper surface of basidiocarps azonate or indistinctly zonate, dull brown; context usually less than 1 mm thick. 2

1. Upper surface of basidiocarps usually zonate, often with bright yellowish or reddish brown zones; context often up to 3-4 mm thick.

Gloeophyllum saepiarium (Wulf. ex Fr.) Karst. Basidiocarps effused-reflexed to sessile; hyphal system dimitic; generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent, 8-11 x 3-3.5 µm. (Syn.: *Lenzites saepiaria* (Wulf. ex Fr.) Fr.)

2. Hymenial surface often completely poroid, varying to lamellate

Gloeophyllum trabeum (Pers. ex Fr.) Murr. Basidiocarps effused-reflexed to sessile; hyphal system dimitic, generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent, 7.5-9 x 3-3.5 µm. (Syn.: *Lenzites trabea* Pers. ex Fr.)

2. Hymenial surface completely lamellate

Gloeophyllum striatum (Swartz ex Fr.) Murr. Basidiocarps usually sessile; hyphal system dimitic; generative hyphae with clamps; cystidia cylindric; basidiospores cylindric, hyaline, negative in Melzer's reagent 6-8 x 2-4 µm. (Syn.: *Lenzites striata* (Swartz ex Fr.) Fr.)

Key to species of *Laetiporus*

1. Contextual tissue white; pileus surface orange; pore surface yellow

Laetiporus sulphureus (Bull. ex Fr.) Bond. et Sing. Basidiocarps often in imbricate clusters, sessile on wood, bleaching to a white crumbly mass after weathering; some contextual hyphae thick-walled, aseptate, much branched and interlocking; basidiospores ovoid to ellipsoid, hyaline, negative in Melzer's reagent, 5-7.5 x 4-5 µm. (Syn.: *Polyporus sulphureus* Bull. ex Fr.).

1. Contextual tissue pinkish buff; pileus surface light buff to pinkish brown; pore surface cream colored or brownish on drying

Laetiporus persicinus (Berk. et Curt.) comb. nov. (basionym - *Polyporus persicinus* Berk. et Curt., Grevillea 1:37. 1872).

Basidiocarps stipitate, terrestrial from buried wood; contextual hyphae thin- to thick-walled, some much branched; spores broadly ellipsoid to subglobose, hyaline, negative in Melzer's reagent, 5-8 x 4-5 µm. (Syn.: *Scutiger persicinus* (Berk. et Curt.) Murr.)

Key to species of *Phaeolus*

1. Basidiocarps sessile, effused-reflexed or resupinate; pore surface and context bright orange. 2
1. Basidiocarps stipitate to sessile, context brown; pore surface greenish brown when fresh, becoming dark rusty brown

Phaeolus schweinitzii (Fr.) Pat. Basidiocarps solitary on ground to imbricate on standing trees and stumps; circular or irregular lobed to dimidiate; upper surface bright yellowish brown at first, becoming dark brown, tomentose to hirsute; hyphae thin- to thick-walled, simple-septate; cystidia abundant, cylindric, not incrusted, 7-13 µm in diam, projecting to 75 µm; vascular hyphae with dark contents present in hymenium; basidiospores ellipsoid to ovoid, hyaline, negative in Melzer's reagent, 6-9 x 3.5-5 µm. (Syn.: *Polyporus schweinitzii* Fr.)

2. Pores 1 mm or more in diam; basidiospores 10-14 µm long

Phaeolus alboluteus (Ell. et Ev.) Pilát. Basidiocarps commonly effused for 1 meter or more, narrowly reflexed to resupinate, developing in spring in snow and deteriorating rapidly after snow melts; upper surface soft and spongy, bright orange; hyphae thin- to thick-walled, simple-septate, bright red then hyaline in KOH; cystidia abundant, cylindric, 6-9 µm in diam and projecting up to 80 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 10-14 x 3-4 µm. (Syn.: *Polyporus alboluteus* Ell. et Ev.)

2. Pores 2-3 per mm; basidiospores 5-6 µm long

Phaeolus fibrillosus (Karst.) Bourd. et Galz. Basidiocarps usually sessile, solitary or imbricate, up to 9 cm wide; upper surface orange, becoming hispid to radially fibrillose; hyphae thin- to thick-walled, simple-septate, bright red, then hyaline in KOH; cystidia cylindric, 3.5-4.5 µm in diam, projecting to 35 µm; basidiospores short-chlindric, hyaline, negative in Melzer's reagent, 5-6 x 2.5-3 µm. (Syn.: *Polyporus fibrillosus* Karst.)

Key to species of *Poria*

1. Generative hyphae simple-septate. 2
1. Generative hyphae with clamps 3
   2. Basidiospores 8-11 x 3-4 µm; pores 1-2 per mm

Poria cocos (Schw.) Wolf. Basidiocarps sometimes associated with buried sclerotia or "tuckahoes"; pore surface light ochraceous buff to pinkish buff; some hyphae up to 20 µm in diam; aseptate skeletal hyphae present; cystidia lacking; basidiospores cylindric, hyaline, negative in Melzer's reagent.

2. Basidiospores 4-5 x 2.5-3.5 µm; pores 3-5 per mm.

Poria inflata Overh. Pore surface whitish to cream colored or tan; tube layer drying rapid and brittle; monomitic; some hyphae up to 20 µm in diam; fusoid cystidia present; basidiospores oblong to ovoid, hyaline, negative in Melzer's reagent.

3. Hyphal system monomitic. 4
3. Hyphal system dimitic or trimitic 12
    4. Cystidia present 5
    4. Cystidia absent. 6
5. Pore surface yellow, drying yellowish buff

Poria aurea Pk. Basidiocarps annual pores 2-4 per mm; tube layer soft and cheesy on dried specimens; cystidia imbedded or projecting, thick-walled, ventricose, mostly apically incrusted, 20-50 x 12-25 µm, projecting to 15 µm; basidiospores narrowly ellipsoid, hyaline, negative in Melzer's reagent, 5-7 x 3-3.5 µm.

5. Pore surface white to light buff

Poria sericeomollis (Rom.) Egel. Basidiocarps annual; pores 4-6 per mm; cystidia occasional to abundant, ventricose, thick-walled, some apically incrusted, barely projecting, 14-26 x 6-10 µm; basidiospores oblong to cylindric-ellipsoid, hyaline, negative in Melzer's reagent, 4-5 x 2-2.5 µm. (Syn.: *Poria asiatica* (Pilát) Overh.)

    6. Basidiospores hyaline. 7
    6. Basidiospores brown at maturity

Poria incrassata (Berk. et Curt.) Burt. Basidiocarps annual; rhizomorphic; pore surface becoming brown on drying; pores 1-3 per mm; subiculum often with a dark, hard layer above the tubes; basidiospores ellipsoid, becoming brown, thick-walled, 8-13 x 4-6.5 µm. (Syn.: *Serpula incrassata* (Berk. et Curt.) Donk)

7. Pore surface brightly colored. 8
7. Pore surface white to light buff 10

    8. Pore surface yellow to lavender. 9
    8. Pore surface pale pink

Poria placenta (Fr.) Cke. Basidiocarps annual; taste mild; pores 3-4 per mm; basidiospores oblong to oblong-ellipsoid; hyaline, smooth, 5-7 x 2-3.5 µm. (Syn.: *Poria microspora* Overh.)

9. Pore surface pale yellow; margin with yellow rhizomorphs

Poria albolutescens (Rom.) Egel. Basidiocarps annual, soft and fragile; pores 3-4 per mm; basidiospores oblong, hyaline, weakly amyloid in Melzer's reagent, 3-4.5 x 2-3.5 µm.

9. Pore surface variable in color, yellowish buff to lavender; margin not rhizomorphic

Poria bombycina (Fr.) Cke. Basidiocarps annual, soft; pores 2-3 per mm; basidiospores broadly ellipsoid, hyaline, weakly amyloid in Melzer's reagent, 5-8 x 3-5 µm.

10. Fusoid cystidioles lacking. 11
10. Fusoid cystidioles abundant in hymenium

Poria crassa (Karst.) Sacc. Basidiocarps perennial; taste bitter; pores 5-6 per mm; tube layer waxy, up to 1.5 cm thick; fusoid cystidioles present; basidiospores oblong to oblong-ellipsoid, 4-8 x 3-4 µm.

11. Basidiospores oblong to short-cylindric, 6-8 x 2-3 µm

Poria rancida Bres. Basidiocarps annual; taste rancid; pores 1-4 per mm; basidiospores hyaline, negative in Melzer's reagent.

11. Basidiospores cylindric, 7-11 x 2-3 µm

Poria mappa Overh. et Lowe. Basidiocarps annual, taste mild; basidiospores hyaline, negative in Melzer's reagent.

12. Basidiospores ovoid to ellipsoid 12
12. Basidiospores cylindric to oblong 18
13. Basidiospores smooth. 14
13. Basidiospores echinulate

Poria lenta Overh. et Lowe. Basidiocarps annual; rhizomorphs present beneath basidiocarps; pores 2-3 per mm; basidiospores broadly ovoid to subglobose, hyaline, amyloid in Melzer's reagent, 5-6 x 4-5 µm.

14. Pore surface and context white to light buff or orange-yellow. 18
14. Pore surface and context dark purplish brown

Poria nigra (Berk.) Cke. Basidiocarps perennial; pores 4-8 per mm; context dark purplish brown, often with a dark hard layer next to the substratum; basidiospores hyaline, ovoid to narrowly ellipsoid, negative in Melzer's reagent, 3-5 x 2-3 µm.

15. Pore surface white to cream colored or pale buff. 16
15. Pore surface bright orange yellow

Poria radiculosa (Pk.) Sacc. Basidiocarps annual; pores 3-4 per mm; margin fimbriate to strongly rhizomorphic; rhizomorphs cream colored, up to 2 mm in diam; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6-7 x 3-4 µm.

16. Basidiospores 5-7 µm long 17
16. Basidiospores 3-4 µm long

Poria sequoiae Bonar. Basidiocarps annual, pores 3-4 per mm; subiculum white; basidiospores oblong-ellipsoid to ellipsoid, 3.5-5 x 2-3.5 µm.

17. Tubes and context drying soft

Poria vaillantii (DC. ex Fr.) Cke. Basidiocarps annual; pores 2-4 per mm; margin often with white rhizomorphs; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 5-6.5 x 3-4.5 µm.

17. Tubes drying firm and rigid; context soft

Poria gossypium Speg. Basidiocarps annual; pores 4-6 per mm; subiculum white, soft-fibrous; basidiospores ovoid to ellipsoid, hyaline, negative in Melzer's reagent, 5-7 x 2-3.5 µm.

18. Subiculum uniform in color 19
18. Subiculum with a dark brown layer next to the substratum

Poria albobrunnea (Rom.) Baxt. Basidiocarps annual; pore surface drying reddish brown, pores 5-7 per mm; hyphae of brown layers pale to dark brown in KOH; basidiospores allantoid, hyaline, negative in Melzer's reagent, 5-7 x 1.5-2 µm.

19. Pore surface bright yellow when fresh 20
19. Pore surface white to cream colored or light buff. 21

20. Basidiocarps perennial; pores 1-5 per mm

Poria alpina Litsch. Basidiocarps perennial; taste bitter; pores 3-4 per mm; tubes chalky when dry; context tough, firm; fusoid cystidioles abundant; basidiospores allantoid, hyaline, negative in Melzer's reagent, 3-4 x 1.5-2 µm.

20. Basidiocarps annual; pores 5-7 per mm

Poria xantha (Fr.) Cke. Basidiocarps frequently on charred logs, annual, crumbly or chalky when dry; pores 5-7 per mm; taste bitter; skeletal hyphae weakly amyloid in Melzer's reagent; fusoid cystidioles abundant; basidiospores allantoid, hyaline, negative in Melzer's reagent, 3.5-5 x 1.5-2 µm.

21. Tissue not reacting in Melzer's reagent 22
21. All tissue strongly amyloid in Melzer's reagent

Poria carbonica Overh. Basidiocarps annual; pores 3-5 per mm tube layer up to 1 cm thick; taste mild; basidiospores short-cylindric to oblong, hyaline, negative in Melzer's reagent, 5-5.5 x 2.5-3 µm.

22. Pores 2-4 mm. 23
22. Pores 4-7 per mm 24
23. On conifers; basidiospores allantoid

Poria sinuosa (Fr.) Cke. Basidiocarps annual, tough; taste resinously bitter; pores circular to sinuous, 2-4 per mm; basidiospores hyaline, negative in Melzer's reagent, 4-5.5 x 1.5-2 µm.

23. On hardwoods; basidiospores oblong

Poria oleracea Davids. et Lombard. Basidiocarps perennial; pores 2-4 per mm; tube layer and subiculum chalky to brittle when dry; fusoid cystidioles present; basidiospores oblong, tapered toward the apiculus; hyaline, negative in Melzer's reagent, 5-7.5 x 2-3 µm.

24. Basidiospores up to 10 µm long 25
24. Basidiospores up to 6.5 µm long 26

25. On juniper; binding hyphae lacking

Poria ferox Long et Baxter. Basidiocarps perennial; pores 4-6 per mm; fusoid cystidioles present; basidiospores cylindric, often fusoid, hyaline, negative in Melzer's reagent, 6.5-8 x 2.5-3 µm.

25. On other conifers; binding hyphae present

Poria stenospora Overh. Basidiocarps annual; pores 6-7 per mm; hyphal pegs present; basidiospores cylindric, hyaline, negative in Melzer's reagent, 6-10 x 2-2.5 µm.

26. Basidiospores oblong. 27
26. Basidiospores narrowly allantoid

Poria odora (Pk.) Sacc. Basidiocarps annual; taste mild; odor of fresh basidiocarps and rot strong, garlic-like; pores 4-6 per mm; fusoid cystidioles present; basidiospores hyaline, negative in Melzer's reagent; 5-6.5 x 1-1.5 µm.

27. Margin usually becoming resinous and reddish brown

Poria sitchensis Baxter. Basidiocarps annual, with a strong sweet odor when fresh; pores 4-7 per mm; margin often resinous and reddish brown; taste resinously bitter; globules of exudate abundant in KOH solution; tramal hyphae weakly amyloid in Melzer's reagent; basidiospores cylindric, hyaline, negative in Melzer's reagent, 4-5 x 1.5-2 µm.

27. Margin not resinous and reddish-brown

Poria oleagina Overh. Basidiocarps perennial, becoming crumbly, chalky; pores 4-6 per mm; fusoid cystidiole present; basidiospores short cylindric to oblong, 3.5-5 x 1.5-2 µm.

Key to species of *Tyromyces* that cause brown rots

1. Hyphae with clamp connections 2
1. Hyphae simple-septate

Tyromyces mollis (Pers. ex Fr.) Kotl. et Pouz. Basidiocarps sessile, effused-reflexed, or resupinate; upper surface pale purplish brown, glabrous, becoming rugose; pore surface and context pale pinkish brown; cystidia lacking; basidiospores allantoid, hyaline, negative in Melzer's reagent, 4.5-5.5 x 1-1.5 µm. (Syn.: *Polyporus mollis* Pers. ex Fr.)

2. Basidiospores negative in Melzer's reagent. 3
2. Basidiospores dextrinoid in Melzer's reagent

Tyromyces transmutans (Overh.) Lowe. Basidiocarps usually narrowly reflexed, often resupinate, rarely sessile; upper surface whitish, becoming blotched with reddish brown or bruising on drying; cystidia lacking; basidiospores ellipsoid to short-cylindric, 5-6 x 2-3 µm. (Syn.: *Polyporus subcartilagineus* Overh.; *Tyromyces kravtzevianus* Bond. et Parm.)

3. Gloeocystidia or fusoid cystidia present in hymenium. 4
3. Cystidia lacking. 5
    4. Gloeocystidia present; cystidia lacking

Tyromyces leucomallellus Murr. Basidiocarps effused-reflexed, resupinate, or sessile; upper surface white, drying with reddish brown patches, fibrillose to glabrous; hyphal pegs present; gloeocystidia rare to abundant, imbedded or projecting; basidiospores cylindric, slightly curved, hyaline, 4.5-6 x 1-1.5 μm.

    4. Fusoid cystidia present; gloeocystidia lacking

Tyromyces balsameus (Pk.) Murr. Basidiocarps sessile or effused-reflexed, solitary or in imbricate clusters, dimidiate or laterally fused and elongated; upper surface whitish to pale brownish, faintly zonate; cystidia numerous, often incrusted, 11-21 x 5-7 μm; basidiospores ovoid to ellipsoid, 3.5-4 x 2.5-3 μm. (Syn.: *Polyporus balsameus* Pk.)

5. Basidiospores ellipsoid to ovoid. 6
5. Basidiospores cylindric to allantoid 8
    6. On hardwoods; hyphal system dimitic or trimitic. 7
    6. Restricted to incense cedar; hyphal system monomitic

Tyromyces amarus (Hedgc.) Lowe. Basidiocarps sessile, ungulate, up to 16 cm wide; upper surface drying ochraceous; gloeoplerous hyphae present, cystidia lacking; basidiospores oblong to ellipsoid, thick-walled, 6.5-7.5 x 3.5-4.5 μm. (Syn.: *Polyporus amarus* Hedgc.)

7. Basidiocarps up to 20 cm wide, drying very light in weight; thick-walled, context soft-felty

Tyromyces trichrous (Berk. et Curt.) Lowe. Basidiocarps centrally to laterally substipitate to sessile; upper surface ochraceous, glabrous to tomentose; context soft-felty, cream colored; basidiospores ellipsoid to ovoid or slightly curved, 4-5 x 2.5-3.5 μm. (Syn.: *Polyporus trichrous* Berk. et Curt.; *Polyporus pseudosulphureus* Long)

7. Basidiocarps smaller, up to 15 cm wide, drying firm

Tyromyces spraguei (Berk. et Curt.) Murr. Basidiocarps sessile to effused-reflexed; upper surface cream colored to pale buff, developing reddish brown to blackish areas on drying, especially at the margin; context cream colored, firm and fissile on drying; basidiospores subglobose to broadly ellipsoid, 5.6-5 x 4.5-5 μm. (Syn.: *Polyporus spraguei* Berk. et Curt.)

    8. Hyphal system monomitic. 9
    8. Hyphal system dimitic or trimitic with distinct skeletal hyphae

Tyromyces palustris (Berk. et Curt.) Murr. Basidiocarps sessile or effused-reflexed; upper surface cream colored to pale reddish brown, glabrous; context cream colored, fibrous, firm, up to 2.5 cm thick; gloeoplerous hyphae present, cystidia lacking; basidiospores cylindric to oblong, 6-7.5 x 2.5-3 µm. (Syn.: *Polyporus palustris* Berk. et Curt.)

9. Basidiocarps white to rufescent, not with blue tints. 10
9. Basidiocarps whitish with a blue or grayish blue cast

Tyromyces caesius (Schrad. ex Fr.) Murr. Basidiocarps sessile or effused-reflexed, solitary, dimidiate or narrow and shelf-like; cystidia lacking; basidiospores cylindric to allantoid, 4.5-6 x 1-1.5 µm. (Syn.: *Polyporus caesius* Schrad. ex Fr.)

10. Basidiocarps white to pale buff, not discoloring markedly on bruising or drying. 11
10. Basidiocarps cream colored to pale buff, staining dark reddish brown on bruising or drying

Tyromyces fragilis (Fr.) Donk. Basidiocarps sessile or effused-reflexed, dimidiate to elongated; hyphal pegs present; basidiospores allantoid, 4-5 x 1-2 µm. (Syn.: *Polyporus fragilis* Fr.)

11. Upper surface of basidiocarps tomentose to glabrous. 12
11. Upper surface of basidiocarps cottony, growing down over and partially enclosing pore surface

Tyromyces leucospongia (Cke. et Harkn.) Bond. et Sing. Basidiocarps effused-reflexed to sessile, dimidiate to elongate, developing under snow; upper surface white to pale buff with a thick layer of soft, cottony tomentum, basidiospores allantoid, 4.5-6 x 1-1.5 µm. (Syn.: *Polyporus leucospongia* Cke. et Harkn.)

12. Upper surface without shallow, circular depressions. . . .13
12. Upper surface with shallow, circular depressions

Tyromyces guttulatus (Pk.) Murr. Basidiocarps sessile to substipitate, dimidiate to flabelliform, applanate; upper surface glabrous, cream colored to pale buff; tissues with a bitter taste; gloeopleurous hyphae present; fusoid cystidioles present; basidiospores short-cylindric, 4-5 x 2-2.5 µm. (Syn.: *Polyporus guttulatus* Pk.)

13. On dead conifers or hardwoods. 14
13. On living Monterey and Arizona cypress and juniper

Tyromyces basilaris (Overh.) K. J. Martin. Basidiocarps sessile to laterally substipitate, flabelliform to dimidiate, single or umbricate; upper surface light buff, zonate, tomentose to radially fibrillose; single and double clamps present; hyphal pegs present; basidiospores oblong to cylindric-ellipsoid, 4.5-5 x 2-3 µm. (Syn.: *Polyporus basilaris* Overh.)

14. Tissue not bitter 15
14. Tissue bitter tasting. .16
15. Pores large, 1-3 per mm; reflexed specimens with undulate margin

Tyromyces undosus (Pk.) Murr. Basidiocarps effused-reflexed or occasionally resupinate, upper surface cream colored to pale buff; basidiospores allantoid, 4-7 x 1-1.5 µm. (Syn.: *Polyporus undosus* Pk.)

15. Pores smaller, 3-4 per mm; reflexed portions not undulate

Tyromyces lowei (Pilát) Bond. Basidiocarps effused-reflexed to sessile; upper surface whitish with reddish radial streaks; basidiospores allantoid, 4.5 x 1.5-2 μm. (Syn.: *Leptoporus lowei* Pilát)

16. Basidiocarps effused-reflexed to sessile, pileus elongate to dimidiate 17
16. Basidiocarps petaloid with a narrowed base or imbricate in centrally attached rosettes

Tyromyces floriformis (Quél.) Bond. et Sing. Upper surface white to cream colored or darkening on drying, sometimes radially fibrillose; margin acute, usually incurved; hyphal pegs present; basidiospores oblong to cylindric-ellipsoid. 3.5-5 x 2-2.5 μm. (Syn.: *Polyporus floriformis* Quél.)

17. Upper surface rough to tomentose, white to light buff. 18
17. Upper surface of basidiocarps smooth, pellicular, cream colored to mousy gray.

Tyromyces lacteus (Fr.) Murr. Basidiocarps sessile or effused-reflexed, elongate to dimidiate; pore surface white, becoming yellowish on drying; basidiospores cylindric to allantoid, 4-5 x 1-2 μm.

18. Basidiocarps soft-fibrous on drying

Tyromyces perdelicatus Murr. Basidiocarps sessile to effused-reflexed; pilei dimidiate to elongate; context drying soft-fibrous, tubes drying soft; basidiospores allantoid, 4-5.5 x 1-1.5 μm. (Syn.: *Polyporus perdelicatus* (Murr.) Murr.)

18. Basidiocarps firm and rigid on drying

Tyromyces stipticus (Fr.) Kotl. et Pouz. Basidiocarps usually sessile; pilei dimidiate; context frying hard, tubes drying brittle; basidiospores cylindric to oblong 3.5-5 x 1.5-2 μm. (Syn.: *Polyporus stipticus* Fr.; *Polyporus immitis* Pk.)

Family SPARASSIDACEAE

Single genus - *Sparassis* Fr.

Key to species of *Sparassis*

1. Lobes of basidiocarp thin, crisp, cream colored to buff

Sparassis crispa Wulf. ex Fr. Basidiocarps annual, usually from roots on a perennial, elongated underground pseudosclerotium as a rounded cluster of many anastomosing petaloid lobes with thin, wavy margins; cream colored to yellowish tan; hyphae irregularly inflated, mostly with clamps; aseptate gloeoplerous hyphae present; basidiospores ellipsoid, hyaline; negative in Melzer's reagent, 5-7 x 3-5 μm. (Syn.: *Sparassis radicata* Weir)

1. Lobes of basidiocarps thick, brown with a paler marginal zone

Sparassis herbstii Pk. Basidiocarps annual, arising from a central stalk as many anastomosing branches in rounded clusters; lobes flattened, fleshy-tough when fresh, drying cartilaginous; contextual hyphae mostly thick-walled, 4-12 µm in diam, simple-septate; subhymenial hyphae with clamps; refractive hyphae present at base of basidiocarp; basidiospores ellipsoid, hyaline, negative in Melzer's reagent, 6-7 x 4.5-5.5 µm.

Family STEREACEAE

Key to genera

1. Hymenial surface smooth. . . . . *Columnocystis* Pouz.
1. Hymenial surface with projecting fascicles of sterile hyphae . . . . *Veluticeps* Cke. emend. Pat.

Veluticeps berkeleyi (Berk. et Curt.) Cke. Basidiocarps sessile, effused-reflexed or resupinate; hymenial surface brown; dimitic; generative hyphae with clamps; basidia narrowly clavate, up to 75 µm long; basidiospores cylindric, slightly curved, hyaline, negative in Melzer's reagent, 10-14 x 4-5 µm. (Syn.: *Veluticeps fusca* Humphrey et Long)

Key to species of *Columnocystis*

1. Generative hyphae with clamps 2
1. Generative hyphae lacking clamps, simple-septate

Columnocystis ambigua (Pk.) Pouz. Basidiocarps effused-reflexed or resupinate; hymenial surface grayish brown; hyphae thin- to thick-walled; cystidia cylindric to clavate, thick-walled, with secondary septa; basidia narrowly clavate, often with secondary septa, 70-120 x 5-8 µm; basidiospores cylindric to fusoid, hyaline, negative in Melzer's reagent, 12-16 x 3.5-4 µm. (Syn.: *Stereum ambiguum* Pk.)

2. Basidiospores 17.5-25 µm long; basidia up to 12 µm in diam

Columnocystis pimeriensis Gilbn. Basidiocarps effused in small confluent patches, resupinate to narrowly reflexed; hymenial surface brown, with glistening, needle-like crystals; hyphae thin- to thick-walled, with clamps and some simple septa; cystidia cylindric, some with secondary septa; basidia up to 110 µm long, with stout sterigmata up to 20 µm long and 4 µm in diam; basidiospores cylindric to ellipsoid, hyaline, negative in Melzer's reagent, 17.5-25 x 7-10 µm.

2. Basidiospores 10-15 µm long; basidia 8-9 µm in diam

Columnocystis abietina (Pers. ex Fr.) Pouz. Basidiocarps sessile, effused-reflexed, or resupinate; hymenial surface grayish brown, with glistening needle-like crystals; dimitic; generative hyphae with clamps; cystidia abundant, narrowly clavate, with a thick wall that thins at the apex, 100-300 x 6-8 µm, some with secondary septa; basidia narrowly clavate, 85-120 x 8-9 µm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 10-15 x 4-5.5 µm. (Syn.: *Stereum abietinum* (Pers. ex Fr.) Fr.; *Stereum rugisporum* (Ell. et Ev.) Burt)

AGARICALES

Key to families containing brown-rot fungi

1. Spore print white . . . . .TRICHOLOMATACEAE
1. Spore print pale brown to black 2
    2. Spore print black; basidiocarps deliquescing at maturity . . . . COPRINACEAE
    2. Spore print pale brownish; basidiocarps not deliquescing at maturity . . . . PAXILLACEAE

Family COPRINACEAE

One genus contains brown-rot fungi - *Coprinus* (Pers. ex Fr.) S. F. Gray

Key to species of *Coprinus* that cause brown rots

1. Upper surface of pileus lacking glistening, mica-like particles

Coprinus atramentarius (Bull. ex Fr.) Fr. Basidiocarps centrally stipitate, single to clustered, 4-10 cm tall; pileus conical, becoming campanulate; up to 6 cm wide; upper surface grayish to brownish, dry; gills free, crowded, pale grayish white, becoming black; contextual hyphae with clamps, up to 20 µm in diam; cuticle with swollen cells up to 30 µm in diam; pleurocystidia present; basidia separated by larger sterile cells 10-20 µm diam; basidiospores ellipsoid, dark blackish brown, truncate with a large pore at apex, 9-12 x 5-6 µm.

1. Upper surface with glistening mica-like particles

Coprinus micaceus (Bull. ex Fr.) Fr. Basidiocarps centrally stipitate, usually in dense clusters; pilei 1-5 cm diam, conical to campanulate; upper surface pale buff to darker brownish, radiately striate; gills crowded, white, becoming black; contextual hyphae with clamps; subhymenial tissue of gill trama dextrinoid; pleurocystidia present; basidiospores ovoid to narrowly ellipsoid; dark brown in KOH, truncate and with a large pore at apex, 5.5-8 x 4.5-6 µm.

Family PAXILLACEAE

Key to genera that contain brown-rot fungi

1. Basidiocarps sessile or laterally substipitate . . . *Paxillus* Fr.
1. Basidiocarps centrally stipitate .*Hygrophoropsis* (Schroet.) Maire

Hygrophoropsis aurantiacus (Fr.) Maire. Basidiocarps centrally stipitate, single to gregarious; pileus up to 6 cm wide; upper surface orange-yellow to brownish orange, finely strigose; gills decurrent; stalk orange; contextual hyphae with clamps; basidiospores ellipsoid, hyaline in KOH, weakly dextrinoid in Melzer's reagent, 5-7 x 3-4 µm. (Syn.: *Clitocybe aurantiaca* (Fr.) Studer)

Key to species of *Paxillus*

1. Basidiocarps laterally substipitate; upper surface rusty brown

Paxillus atrotomentosus (Batsch. ex Fr.) Fr. Basidiocarps single or in clusters; gills decurrent; stipe with dense dark brown hairs; basidiospores ovoid, clay color in mass, dextrinoid in Melzer's reagent; 5-7 x 3-4 μm.

1. Basidiocarps sessile; upper surface ochraceous buff

Paxillus panuoides Fr. Basidiocarps 2-7 cm wide, single or in confluent clusters; upper surface ochraceous buff, moist, slightly strigose at base; gills pinkish buff; context white; contextual hyphae with clamps; cystidia lacking; basidiospores ellipsoid, hyaline, dextrinoid in Melzer's reagent, 4.5-5 x 3-3.5 μm.

Family TRICHOLOMATACEAE

One genus contains brown-rot fungi - *Lentinus* Fr.

Key to species of *Lentinus* that cause brown rots

1. Annulus absent 2
1. Annulus present

Lentinus lepideus Fr. Basidiocarps up to 15 cm in diam, stipe with recurved squamules at apex; gloeoplerous hyphae present in context; cylindric to fusoid pleurocystidia abundant, 40-60 x 3-5 μm; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-11 x 3-3.5 μm.

2. Basidiocarps small, 1-8 cm wide. 3
2. Basidiocarps large, up to 27 cm wide

Lentinus ponderosus O. K. Miller. Basidiocarps up to 27 cm wide; stipe lacking round squamules at apex; gloeoplerous hyphae present in context; pleurocystidia cylindric to fusiform, 4.5 x 3-4.5 μm; barely projecting; basidiospores cylindric, hyaline, negative in Melzer's reagent, 9-11 x 3-3.5 μm.

3. Basidiocarps up to 8 cm wide; upper surface tomentose to glabrous; on Sitka spruce

Lentinus kauffmanii A. H. Smith. Basidiocarps centrally to excentrically stipitate; gills crowded, decurrent and extending down stipe 1-2 cm; pleurocystidia abundant, cylindric to ventricose, 60-100 x 7-12 μm; cheilocystidia present; hyphae with clamps; basidiospores cylindric or slightly curved, hyaline, pale red in Melzer's reagent, 5-6 x 2 μm.

3. Basidiocarps up to 3 cm wide; upper surface with reddish brown radial fibrillose scales

Lentinus sulcatus Berk. Basidiocarps centrally stipitate, gills distant, free to adnate, edges appearing granulose under 30 x lens; hyphae without clamps, some thin-walled, simple-septate, others thick-walled, aseptate; pleurocystidia cylindric to fusoid, 60-100 x 7-10 μm; cheilocystidia present; basidiospores broadly cylindric, hyaline, negative in Melzer's reagent, 10-14 x 5-6 μm. (Syn.: *Panus fulvidus* Bres.)

Table 1. Annotated check list of North American brown-rot fungi

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
AMYLOCYSTIS LAPPONICA	dead conifers	MI MN; NH NY VT; AK AZ CO ID MT OR UT WY; AT BC MB OT QB	IV	63,140,161	27,62,63,69,111, 112,121,142,147, 152
AMYLOSPORUS GRAMINICOLA	living hardwoods	TX; AZ CA	ND	75	75,111,146
CHAETODERMA LUNA	dead conifers	AK AZ CO ID MT UT	ND	4,127,161	4,64,69,88,120, 127
COLUMNOCYSTIS ABIETINA	dead conifers	NY AK AZ CO ID MT OR UT WA WY; AT BC NF NS NWT YT	ND	26,138, 141,161	26,37,64,69,93, 104
C. AMBIGUA	dead conifers	NC TN; ME NY VT	ND	161	34,37,93
C. PIMERIENSIS	dead ponderosa pine	AZ	ND	ND	69
CONIOPHORA ARIDA	dead conifers and hardwoods	LA NC; IL MO: MA NJ NY PA RI VT; AZ CO ID MT; MB NS ON QB	ND	97,163	35,69,107,123
C. EREMOPHILA	dead desert hardwoods and juniper	AZ	ND	ND	71,72,106
C. FUSISPORA	dead conifers	NJ; BC NS	ND	ND	35,123
C. PUTEANA	dead conifers and hardwoods, structural timbers	DC; IA IL MI MO OH; MA NJ NY PA VT; AK AZ CA CO ID MT WA; AT BC MB NB NS OT QB	0	26,40,50, 56,138,141	26,31,35,40,69, 87,88,107,117,123
C. SUFFOCATA	dead conifers and hardwoods	DC FL LA; IL IN MO; MA NJ NY PA VT; ID MT WA; BC NS OT	ND	ND	35,76

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
CONIOPHORELLA OLIVACEA	dead conifers and hardwoods	AL GA LA SC; MO OH; MD NH NJ NY PA VT; AZ CO ID MT; AT BC MB MN OT NS	ND	97, 131	35,64,69,107,123
COPRINUS ATRAMENTARIUS	Butt rot in aspen	VA; OH; MD NY; AZ CO MT NM WY	ND	149,150	1,107,130,132,144, 158,159
C. MICACEUS	hardwood stumps	MI WI; MD NY; MT; YT	ND	ND	1,107,130,158,159
CORIOLELLUS CARBONARIUS	dead charred conifers	FL GA SC TN; MI MO; NY; AZ CA ID MT NM OR WA	ND	6,140,161	68,69,110,112,113, 121,142
C. HETEROMORPHUS	dead conifers and hardwoods	AL NC TN VA; MI MO MN SD WI; MA ME NH NY PA VT; AK AZ CA CO ID MT NM OR UT WA WY; AT BC NB NS OT QB YT	II	72,97,138 140,141, 148,161	10,27,60,68,69,71, 91,97,107,112,113, 121,142,147,152
C. MALICOLA	dead hardwoods	DC GA LA NC TN; IA IL IN KY MI MO OH SD WA WI; CT NJ NY PA VT WV; AZ MT WY; AT MB OT QB	0	13,61,140, 141,148, 161	13,27,60,68,107, 112,113,142,174
C. SEPIUM	dead conifers and hardwoods	AL AR DC FL GA LA MS NC TN TX VA; IA IL IN KS KY MO NB OH WI; CT DE MA MD NH NJ NY PA WV; AZ CA MT NM OR WA; BC NB OT QB	ND	6,72,138 140,141, 148,161	68,112,113,121, 142
C. SERIALIS	dead conifers and hardwoods	AL AR FL GA LA NC TN TX VA; IA IL KS KY MI MN MO OH WI; CT MA ME MD NH NJ NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY: AT BC MB NF NS NWT OT QB YT	II	6,40,50, 97,137, 138,140, 148,151, 161	2,15,27,31,40,60, 68,69,88,91,92, 97,107,110,112, 113,121,142,143, 147,152,160,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN REFS.
CORIOLELLUS VARIIFORMIS	dead conifers	TN; MI MN; ME NH NY VT; AK CO ID MT OR UT WA; AT BC NB NF NS OT QB YT	II	138,140, 141,148, 161	10,68,112,113,121, 142,152
CRUSTODERMA DRYINUM	dead conifers and hardwoods	AL; AZ NM OR; BC	ND	ND	35,64,69,107,120, 157
C. RESINOSUM	dead conifers	MT OR WA; BC	ND	ND	120
DACRYOBOLUS KARSTENII	dead conifers	AL NC SC; MA NH NJ NY PA VT; AZ ID NM OR WA; BC NS QB	ND	ND	64,69,93,120,157
D. SUDANS	dead conifers and hardwoods	NC TN; MI MN WI; NY MD AZ CO ID NM WY; BC OT	IV	26,161	26,64,69,72,107, 120
DAEDALEA BERKELEYI	dead conifers	AL FL LA MS SC TN TX VA; AZ	ND	ND	112,113,142
D. JUNIPERINA	trunk rot of living junipers	AR DC FL MS NC VA; KS KY MO NB NY; AZ CO OR	ND	140	14,72,112,113,142
D. QUERCINA	dead hardwoods, especially oaks and chestnuts; also on living trees	DC NC VA; IA OH; CT DE ME MD MA NJ NY PA VT WV; CA OR; NS	ND	40,53, 138,140 141,161, 165	27,31,40,62,91, 112,113,140,142, 147,168

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
FISTULINA HEPATICA	heartrot of living oaks	AL AR DC GA NC TN VA: MI OH; CT DE MD NY MD WV	ND	39,40,53	1,27,31,39,40,49, 62,130,162,173
FOMITOPSIS CAJANDERI	dead conifers: rarely on dead hardwoods; heartrot in fruit trees	AL AR FL GA NC TN VA; IA IN KY MI MN NE SD WI; CT MA MD ME NH NJ NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY; AT BC MB NB NS OT PEI QB	II	19,38, 138,140, 141,161 165	19,27,31,62,69, 107,109,112,113, 121,142,152,167, 175
F. MELIAE	dead hardwoods	AL AR FL LA NC TN TX; IN MO NB; AZ	II	38,126, 140,161	113,142
F. OFFICINALIS	trunk rot of living conifers	MI SD WI; AK AZ CA CO ID MT NV OR WA; AT BC OT	ND	38,40, 138,140, 141,161	27,29,30,31,40, 62,65,69,88,91, 109,112,121,128, 142,147
F. PINICOLA	dead conifers, also a trunk rot in conifers and black cherry	NC TN VA; MI MN MO OH SD WI; MA ME NH NY PA VT WV; AK AZ CA CO ID MT NM NV OR UT WA WY; AT BC MB NB NS NF NWT OT PEI QB SK YT	II	6,38,40, 50,97, 133,138, 140,141,	
F. ROSEA	dead conifers and aspen; top rot in Douglas fir	IA; ME NH NY VT; AZ CA CO ID MT NM NV OR UT WY; AT BC NB NS PEI	II	6,38, 138,140, 141,161	27,29,30,31,62, 91,107,109,112, 121,142,147,152, 160

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
GLOEOPHYLLUM SAEPIARIUM	dead conifers and rarely on hardwoods, especially aspen	AL AR FL GA LA MS NC SC TN TX VA; IA IN KS MI MN NB OH SD WI; CT MA MD ME NH NJ NY PA VT WV; AK AZ CA CO ID MT NM OR UT WA WY; AT BC MB NB NF NWT NS OT PEI QB SK YT	II	20,40,43, 97,138, 140,141, 151,161, 165	2,20,27,31,40,62, 69,72,91,97,107, 112,113,121,130, 142,143,147,152, 160
G. STRIATUM	dead junipers and cypress	FL GA NC; AZ	ND	45,140, 151,161	2,112,113,142
G. TRABEUM	dead hardwoods and conifers; important in houses and other structures	AL GA LA MS NC OK SC TN VA; IA IN KS KY MI MN MO NB OH WI; CT MA MD ME NJ NY PA RI VT WV; AZ CA CO ID MT OR; MB NB OT QB	II	24,40,43, 59,138, 140,141, 161,165	27,31,40,59,62, 69,72,91,112,113, 121,142,147,152, 160
HELICOBASIDIUM CORTICIOIDES	dead conifers	AZ CO MT	ND	55,127	55,123,127
HYGROPHOROPSIS AURANTIACUS	dead hardwoods and conifers	AZ ID OR; BC	ND	ND	130,158,159
LAETIPORUS PERSICINUS	root and butt rot of hardwoods and conifers	AR FL NC SC	ND	ND	113
L. SULPHUREUS	butt rot of hardwoods and conifers; also on stumps and logs	AL AR DC FL GA LA MS NC OK TN SC TX VA; IA IL IN KS KY MI MN MO NE OH WI; CT DE MA MD ME NH NJ NY PA RI VT WV; AK AZ CA ID MT OR WA; AT BC MB NB NS OT QB	ND	5,40,53, 138,140, 141,161, 164	1,27,30,31,40,62, 69,91,107,112, 113,121,128,130, 142,147,158,164, 168

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
LENTINUS KAUFFMANII	trunk rot of Sitka spruce	AK CA OR WA; BC	ND	25,138, 141	25,31,123,159
L. LEPIDEUS	butt rot of living conifers and on dead conifers	CT ME NH NY; AZ MT ID; NB NS	ND	40,138, 141	31,40,69,123,128, 130,158,159,160, 169
L. PONDEROSUS	dead conifers	AZ ID	ND	ND	69,129,159
L. SULCATUS	dead hardwoods and junipers	AZ; MD	ND	134	71,72,106,107,159
LEUCOGYROPHANA ARIZONICA	dead conifers	TN; MD NY; AZ NM	ND	78	69,78,120
L. MOLLUSCA	dead conifers and hardwoods	AL TN; IN MA MI; NH NY; AZ ID MT OR WA; BC OT QB NS	ND	78,79,161	36,64,69,78,79, 120
L. MONTANA	dead conifers	NY; ID	ND	ND	36,78
L. OLIVASCENS	dead conifers and hardwoods	AL FL LA NC TX VA; MI OH; CT DE MA ME MD NH NJ NY PA VT; AZ ID NM; NS OT	ND	78,79, 105,161	69,78,79,105,120
L. PINASTRI	dead conifers, rarely hardwoods	NC SC VA; OH WI; NY PA; AZ CA ID NM WA; BC OT QB	ND	78,79,82 140,161	36,69,78,79,82, 107,120,154
L. PULVERULENTA	dead conifers and hardwoods	IN; ME PA; CO; BC NS	ND	78	78
L. ROMELLII	dead conifers	NC; SD WI; ME NH NY VT; AZ ID MT NM; BC NS OT PEI QB	ND	78	78

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURE	GEN. REFS.
LEUCOGYROPHANA SORORIA	dead conifers and hardwoods	MD; WA	ND	ND	36,77,78
OSMOPORUS ODORATUS	dead conifers and conifer wood in service	FL TN VA; MI MN WI; DE ME NH NJ NY PA RI VT; WV; AK AZ CA CO ID MT NM OR UT WA WY; AT BC MB NB NF NS NWT OT YT	II	16,138, 140,141, 161	16,27,62,69,91, 112,113,121,142, 147,152
OSTEINA OBDUCTA	dead conifers; rarely on dead hardwoods	IA MI MN WI; MA NH NY PA; AZ CA CO ID MT NM NV OR WA; BC	ND	140,161	62,88,91,112,121, 142,145,147,152
PAXILLUS ATROTOMENTOSUS	dead conifers; also a butt rot of red pine	DC DC; MN WI; MD NY; ID MT WA	ND	57	1,57,130,159
P. PANUOIDES	dead conifers and on mine timbers	DC FL MI TN VA: MI: MD NY RI WV; AZ ID NV	ND	40,156,166	1,40,69,130
PHAEOLUS ALBOLUTEUS	dead conifers; rarely on aspen	MI NY; AK AZ CA CO ID MT NM OR UT WA WY; AT BC NB OT	ND	11,44, 140,161	11,27,60,69,107, 110,112,121,142, 147,152
P. FIBRILLOSUS	dead conifers; rarely on hardwoods	MI MN; CT MA ME NH NY PA VT WV; AK CA CO ID MT OR WA; AT BC MB NF NS OT PEI QB SK	ND	21,44,138, 140,141, 161	21,27,62,112,113, 121,142,147,152
P. SCHWEINITZII	butt rot of living conifers	AL AR DC FL GA LA NC SC TN TX VA; MI MO SD; CT DE MA MD ME NH NJ NY PA VT WV; AK AZ CA CO HI ID MT NM OR UT WA WY; AT BC MB NB NF NS OT PEI QB	ND	5,40,42, 44,138, 140,141, 161	27,29,30,31,40,62, 69,87,91,112,113, 121,128,130,142, 147,152,155

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURE	GEN. REFS.
PIPTOPORUS BETULINUS	on dead and living birches	NC TN WV; IA KS MI MN WI; CT MA ME NH NJ NY PA VT; AK ID MT WA; AT BC MB NB NS OT PEI QB	II	40,116, 138,140, 141,161	27,31,40,62,112, 113,116,142,147
PORIA ALBOBRUNNEA	dead conifers	AK AZ CO ID MT OR WA; AT BC	ND	108,140	12,60,67,69,108, 110,112,121,145, 147
P. *ALBOLUTESCENS*	dead conifers	LA NC TN; MI IN; NY VT; AK CO ID OR WA; AT	ND	108	16,60,67,108,110, 112,121,147
P. *ALPINA*	dead conifers	ID MT OR	ND	108	87,108,110,112, 121
P. *AUREA*	dead conifers	ME NY; AK AZ NM; BC SK	ND	48,161	17,27,48,60,69, 110,112
P. *BOMBYCINA*	dead conifers; rarely on aspen	MI; MA NH NY WV; AK AZ CO ID MT NM OR WA; OT QB	ND	108,140, 161	27,60,67,69,107, 108,110,112,113, 121,147
P. *CARBONICA*	dead conifers and conifer wood in service	AZ CA ID MT NM NV OR WA; BC	ND	108,137, 138,140, 141,161	67,69,108,110, 112,121
P. *COCOS*	dead conifers and hardwoods	AR DC FL GA MS NC SC TN TX VA; KS KY MN MO; DE MD NH NY PA; CA ID MT OR WA; AT OT NB SK	ND	17,53, 140,161	17,31,51,66,67,69, 107,110,112,113

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
PORIA CRASSA	dead conifers, rarely dead hardwoods	NC; MI OH WI; NY PA; AK AZ MT NM WA; BC	ND	140	27,60,67,69,110, 112,113,147
P. *FEROX*	dead junipers	AR OK; AZ NM OR	ND	17	13,72,110,112,113
P. *GOSSYPIUM*	dead conifers	NY PA; AZ CO; NF OT	ND	ND	60,110,147
P. *INCRASSATA*	dead conifers and structural timbers	AL DC FL GA LA MS OK SC TN TX VA; IL KY; CT NY; CA ID OR WA; BC NB OT	ND	13,140	13,31,36,56,67,90, 110,112,113,121
P. *INFLATA*	heartrot of living oaks and on dead hardwoods	FL; MI MO OH; NY WV	ND	ND	110
P. *LENTA*	dead conifers	FL GA NC SC TN; NY; AZ WA; BC OT	ND	ND	110,113
P. *MAPPA*	dead conifers	NY; ID; BC NF	ND	140	67,110,112,121,147
P. *NIGRA*	dead hardwoods	AL AR FL NC SC TN; IA IL IN KS KY OH MO WI; WV	ND	13,53,161	13,110
P. *ODORA*	dead conifers	NY PA; AZ NM; NB	ND	140	69,110,121
P. *OLEAGINA*	dead conifers	TN; MI MN NH NY PA VT; OT	ND	ND	67,110,121
P. *OLERACEA*	dead hardwoods	AR FL GA LA NC TN; MI OH; MD NY; AZ	ND	140,161	110,113
P. *PLACENTA*	dead conifers and hardwoods structural timbers	MI; NY; AZ CO ID MT NM NV WA; AT BC	II	40,137, 138,140, 141,151,161	14,40,60,67,110, 112,147

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
PORIA RADICULOSA	dead conifers and hardwoods	FL LA MS NC TN; NY; AZ CA ID MT WA	ND	108,161	69,110,112,113
P. RANCIDA	dead conifers	AR TN; NY PA; AZ CO NM	ND	ND	110
P. SEQUOIAE	butt rot of living redwood	CA	ND	137,140, 141	31,99,100,110,112
P. SERICEOMOLLIS	heartrot in western red cedar; also on dead conifers or rarely hardwoods	FL NC SC TN; AZ CA CO ID MT OR WA; BC NB NS NWT	ND	50,108, 138,140, 141,161	10,27,31,33,60,67, 69,108,110,112, 113,121,147
P. SINUOSA	dead conifers	MI NJ NY VT; AK AZ CO ID MT NM OR WA; AT BC NS OT SK	ND	108,140, 141,148, 161	27,60,67,69,72, 92,108,110,147
P. SITCHENSIS	dead conifers	NY; AK AZ CA ID MT NM OR; BC	ND	11	11,67,69,110,112, 121
P. STENOSPORA	dead conifers	CA; WA; BC	ND	ND	67,110,112
P. VAILLANTII	dead conifers and structural timbers	DC NC TN VA; MO; MD NY; AZ CA ID NV OR WA; BC	ND	22,40,108, 138,140, 141,161, 163	22,27,40,60,67,69, 92,108,110,112, 113,121,147
P. XANTHA	dead conifers and hardwoods	NC SC TN WV; AK AZ CA CO ID MT NM OR WA WY; AT BC NS SK	ND	40,50,108, 138,140, 141,151, 161	10,27,40,60,67, 69,92,107,108, 110,112,113,121, 147
PSEUDOMERULIUS AUREUS	dead conifers	NC; MI MN; MA NH NJ NY VT; AZ NM; NS QB	ND	7,140, 151	7,36,69,77

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
SERPULA HIMANTIOIDES	dead conifers	NH NY WV; MO; AZ CO ID WA; AT BC MB NB NS OT QB	IV	8,82 140,151	8,36,56,69,82,87, 107,123
S. LACRIMANS	structural timbers	CT NY; IL; MA NJ; AZ ID NM NV; NS OT	IV	40,82,138, 140,141, 161	36,40,56,82
SPARASSIS CRISPA	butt and root rot of living conifers	AZ CA ID NM OR WA; BC	II	58,76,119, 122	69,76,119,122,123, 130,154,155,158, 171
S. HERBSTII	butt and root rot of living conifers and hardwoods	AR NC SC; MD	ND	76,119	76,119
TYROMYCES AMARUS	trunk rot of incense cedar	CA ID OR	ND	161	28,30,31,111,112, 128,142,170
T. BALSAMEUS	butt rot of living conifers, also on dead conifers	NC TN; MI MN WI; NH NY PA; AZ CA ID MT NM OR WA; BC NB NS OT QB	IV	17,47,50, 138,140, 141,161	17,31,33,62,69, 98,101,111,112, 113,121,124,142
T. BASILARIS	trunk rot of living Monterey and Arizona cypress	AZ CA	ND	3	3,31,142
T. CAESIUS	dead conifers and hardwoods	AL DC NC TN VA; IA KY MI MO OH WI; CT DE ME NJ NY PA WV; AK AZ CA CO ID MT NM OR UT WA; BC MB NB NS OT PEI QB	IV	40,47,81, 140,153, 161	18,27,62,91,107, 111,112,113,121, 142,147,152,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
TYROMYCES FLORIFORMIS	dead conifers	NC TN; MI; MA NH NY PA; AZ CA CO ID OR; MB NS OT	ND	ND	27,62,111,112,113, 142,147
T. FRAGILIS	dead conifers	DC NC TN VA; MI WI; CT MA ME NH NY PA; AK AZ CA CO ID MT NM OR WA; BC	ND	5,40,47, 138,140, 141,161	12,27,62,69,91, 92,107,110,111, 112,113,121,142, 147,152
T. GUTTULATUS	dead conifers; rarely on hardwoods	NC TN VA; IN KY MI MN OH WI; MA ME NH NY PA VT; AZ CA ID MT OR WA; BC MB NF NS OT PEI QB	ND	47,54,138, 140,141, 161	62,69,111,112,113, 121,142,147
T. LACTEUS	dead hardwoods and conifers	DC NC TN; IA IN KS MO NB OH; CT DE MD NJ NY PA VT WV; AZ ID MT NM; BC MB NS OT QB	II	114,140	27,62,69,91,111, 112,113,114,121, 147
T. LEUCOMALLELLUS	dead conifers	MD; MI MN; AZ; MB	ND	47	60,91,111,147
T. LEUCOSPONGIA	dead conifers	AZ CA CO ID MT NM NV NM OR UT WA WY; BC	ND	5,9,21, 47,161	9,21,27,31,107, 111,112,121,142, 152
T. LOWEI	dead conifers	NY	ND	47	27,60,62,111,147
T. MOLLIS	dead conifers	AL AR FL LA TX; MI; NH NY; AZ CA CO ID MT NM OR WA WY, BC NB NS QB	ND	47,138, 140,141, 161	27,62,69,91,111, 112,113,121,142, 147
T. PALUSTRIS	dead conifers and hardwoods	AR DC FL GA LA MS SC TN VA; KY	II	5,126,137, 138,140, 141,161, 174	111,113,142,174

BROWN ROT FUNGUS	SUBSTRATA	DISTRIBUTION	SEX	CULTURES	GEN. REFS.
TYROMYCES PERDELICATUS	dead conifers	AZ CA ID MT OR WA; BC	ND	ND	69,107,111,112, 121,142
T. SPRAGUEI	on living and dead hardwoods	AR DC GA LA NC TN VA; IL IN IO MI MO NE OH; CT MA NH NJ NY PA VT WV; OR WA; OT	II	47,53,126, 140,161	31,111,112,113, 142,172
T. STIPTICUS	dead conifers and hardwoods	TN; MI OH; MA NH NY PA VT; AZ ID NM; BC MB NB NS OT	IV	47,97, 140,161	62,91,97,111,112, 113,142,147,156
T. TRANSMUTANS	dead conifers and hardwoods	TN; NY PA; AZ MT NM NV; QB	ND	46,50, 138,140, 161	60,69,107,110, 111,112,113,121, 142,147
T. TRICHROUS	dead hardwoods	AL FL SC	ND	161	111,115
T. UNDOSUS	dead conifers and hardwoods	NC TN VA; ME NH NY VT WV; AK AZ ID MT NM WA; BC OT	II IV	32,47,140	27,32,60,69,91, 107,110,111,112, 113,121,142,147
VELUTICEPS BERKELEYI	trunk rot of ponderosa pine; also on stumps and logs	AZ NM WA	IV	41,74, 118,161	41,74,87

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CREPIDOTUS CINNABARINUS IN NORTH AMERICA

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ABSTRACT

Collections of *Crepidotus cinnabarinus* Pk. from Canada and the United States are described, illustrated and mapped. A previous report of the species from Alabama is discounted and recent collections from the Great Smoky Mountains National Park, North Carolina, establish the southernmost known location. Light microscope and SEM comparative studies on the type of *C. decurrens* States, the type of *C. cinnabarinus*, and additional materials indicate that a single species is involved.

Crepidotus cinnabarinus Pk. was originally described from materials sent to Charles Horton Peck by L. N. Johnson from Ann Arbor, Michigan (Peck, 1895). This distinctive bright red species was next reported from Ohio by Stover (1910, 1912), and re-recorded from Ann Arbor by Kauffman (1918). Murrill (1917) reported it from Ohio, Michigan and Alabama without citing specimens or any supporting published records. Since then, there have been published discoveries or accounts of the species from Illinois (McDougall, 1922), Iowa (Martin, 1928; Gardner, 1947) and Manitoba (Bisby et al., 1929; Bisby et al., 1938).

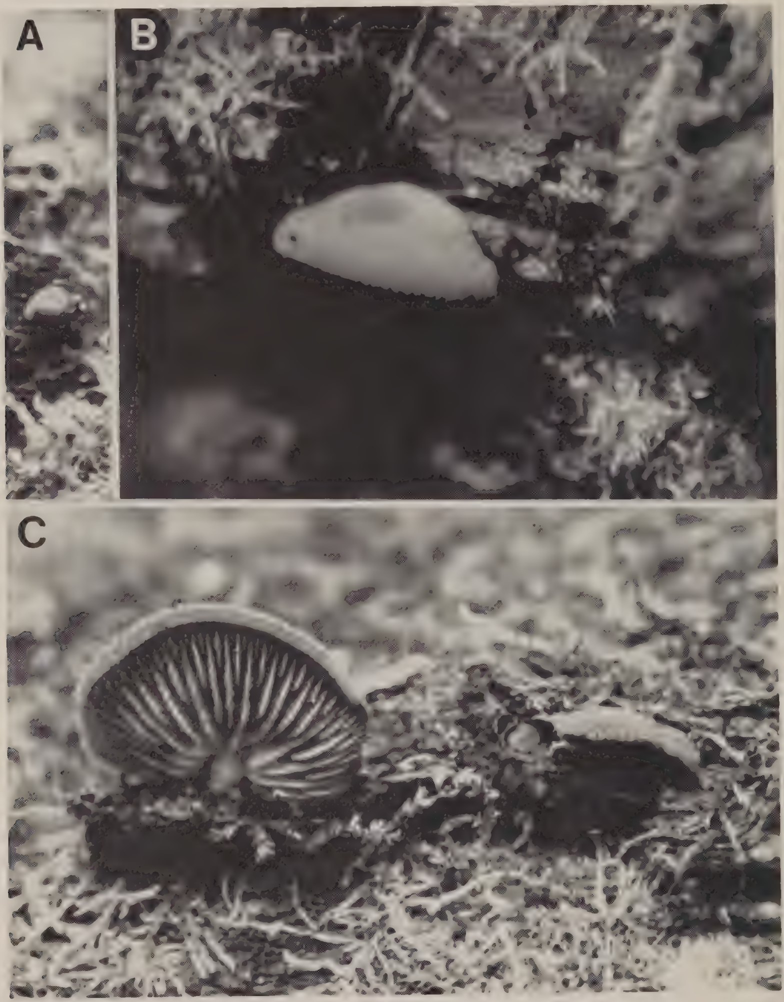


Fig. 1. Crepidotus cinnabarinus in natural habitat. A. Immature sporocarp. B-C. Mature sporocarps. DAOM 174971. ± 2X

Møller & Westergaard (Møller, 1945) described the species as new based on the first known European collections, which were from Denmark. Coincidentally they named it *Crepidotus cinnabarinus* Møller & Westerg. (Møller, 1945). Møller (1946) subsequently realized that the fungus had been previously described by Peck and offered a correction. Pilat (1948) also examined a North American collection which is in the Bresadola herbarium now at Stockholm (S). This collection is possibly from Cincinnati, Ohio as Lloyd is involved as the collector or distributor (Møller, 1946; Pilat, 1948). If Lloyd did indeed collect it, there is no mention in any of his writings (Stevenson, 1933). Hesler & Smith (1965) studied Peck's type material at Albany (NYS) and isotype material deposited at Ann Arbor (MICH). They reported its distribution as Michigan, Ohio, Alabama, presumably based on Murrill (1917), and Denmark. A single collection of *C. cinnabarinus* has also been reported by Bulakh (1977) from the Upper Ussuri River area of extreme Eastern USSR, near its border with Chinese Manchuria, ± 150 miles from the Sea of Japan. We have not seen the collection on which this record is based and therefore cannot confirm its identification. However, the implication of this report on the overall distribution of *C. cinnabarinus* is significant, since it has previously been reported only from Denmark on the Eurasian continents. The taxon could, then, most certainly be expected to occur in adjacent China. Apparently it has not been reported from China so far, according to Tai (1979).

Crepidotus cinnabarinus was reported to be the sole member of *Crepidotus* sect. *Cinnabarini* Hesler & Smith until States (1972) described as new, *C. decurrens* States from Alberta. This taxon was said to differ from *C. cinnabarinus* by its narrower, closer, decurrent lamellae, and its more coarsely ornamented spores which lacked a reddish tint in mass.

Although the spacing, shape and disposition of the lamellae have been used by Hesler & Smith (1965) to help characterize species, as was noted by States (1972), it should be added that they advise caution regarding the use of such characters because of developmental variability (1965: 9). In the case of *Crepidotus cinnabarinus* very limited material was observed by Hesler & Smith and States, resulting in some doubt regarding the potential for lamellar variability. The fact that the spore print from the type of *C. decurrens* lacked reddish tinges is also not definitive, since both McDougall (1922) and Martin (1928) have reported brown spore prints for *C. cinnabarinus*. Finally, the question of spore ornamentation has been open to interpretation.

Peck (1895) in his original description of *Crepidotus cinnabarinus* and Murrill (1917) made no mention of spore ornamentation at all. Kauffman (1918) stated that the spores were "smooth" and Møller (1945) illustrated them as smooth, but later (1946) described them as "slightly rough" ("paulum asperae"). Singer (1947) found them to be "strongly punctate, with heterogeneous wall". Pilat (1948) described the ornamentation for this species as "avec une membrane tres finement verruqueuse" and provided an accurate illustration. In 1950 he also gave the ornamentation for _C_. _cinnabarinus_ as "subtillime et indistincte punctatae" (p. 243) and "minutissime punctatae" (p. 246). Finally, Hesler & Smith (1965) reported "punctate" spores for this species, due to "minute canals extending through the spore wall".

Faced with these doubts and the opportunity of both authors to examine fresh collections, a detailed study of sect. _Cinnabarini_ was undertaken.

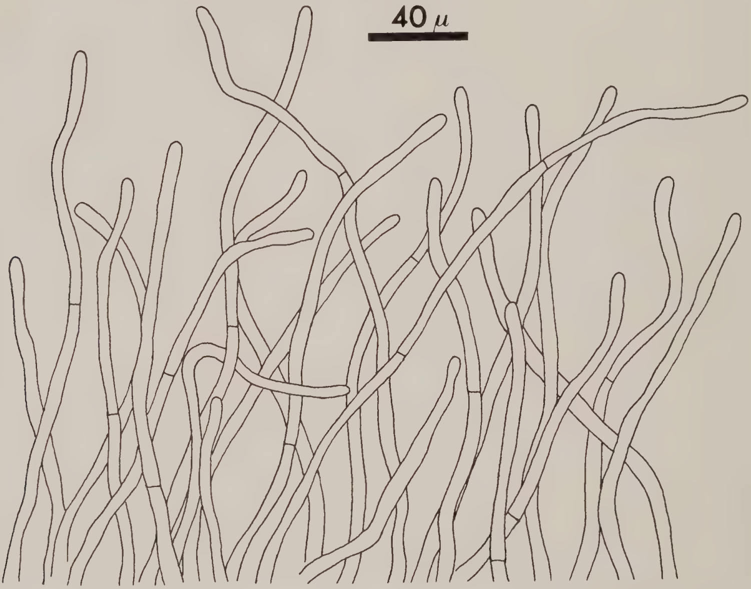


Fig. 2. _Crepidotus_ _cinnabarinus_. Trichodermium. Holotype _C_. _decurrens_.

Comparisons of the holotypes for _Crepidotus_ _cinnabarinus_ and _C_. _decurrens_ as well as additional collections from UBC, MICH, NYS, DAOM, F, NY and TENN were made based on light microscopy. Structures were also examined under the scanning electron microscope (SEM). The SEM stubs were made from either a spore print (DAOM 170700), or from lamellar fragments (holotypes of _C_. _cinnabarinus_ and _C_. _decurrens_ and TENN 41923). These materials were prepared for scanning electron microscopy by thoroughly drying and attaching them to SEM stubs by either double-stick cellophane tape and/or Elmer's Glue, which was allowed to dry and harden overnight. The stubs were then coated with carbon followed by gold in a Denton DV-515 vacuum evaporator at a high vacuum of 2-6 X 10^{-5} torr. Observations were made under an ETEC - Autoscan SEM at a voltage of 20 KV, and photographed using Polaroid Type 665 positive/negative film. Abbreviations of herbaria were taken from Holmgren & Keuken (1974), and color names in quotes are from Ridgway (1912).

Based on the above studies we have found the width of the lamellae and the apparent attachment to the basal plug to vary with age and from collection to collection. The spacing of the lamellae was found to vary around what is a moderate ('close') distance, not being notably distant or crowded and no obvious differences in spacing were noted between the two dried holotypes and other collections.

Although the type of Crepidotus cinnabarinus is very limited and in poor condition, microscopically enough spores were found on a minute lamellar fragment to show that the spore ornamentation is identical to that of the type of C. decurrens (Figs. 4, 5 B-D).

Ornamentation of mature spores of Crepidotus cinnabarinus consists of hemispheric, elongated or slightly irregular, smooth verrucae, often and usually with verruculae (see arrows) in between (Figs. 4, 5 B-D, 6). The elongate verrucae may be straight or curved, and often appear to be composed of two (rarely more) adjacent fused verrucae. The ornamentation is less pronounced in the suprahilar region (Fig. 5 B). A similar situation was found by Pegler & Young (1972) for C. variabilis (Pers. ex Fr.) Kummer.

Crepidotus cinnabarinus has spore ornamentation which most closely approaches what Pegler & Young (1972) have illustrated for C. variabilis. Canals of the type described by Hesler & Smith (1965: 11) for Crepidotus spores, and as seen in the genus Ganoderma as shown by Perreau (1973), were not seen by either Pegler & Young (1972) or by us. Although much more pronounced, the spore ornamentation on Melanoleuca vulgaris Pat. as seen in SEM photographs (Perreau, 1976), is somewhat similar to that of C. cinnabarinus.

Another surprising discovery was the identity of a collection from Alabama deposited in the New York Botanical Garden's herbarium (NY). The collection was made in 1896 at Auburn and was identified as Crepidotus cinnabarinus by C. F. Baker. It was purchased for the N.Y. Botanical Garden in 1902 making it available for Murrill to examine before his report in the North American Flora (1917) and presumably is the basis of his report of that species from Alabama. When reexamined, it was found to be a poorly preserved collection of Panellus stipticus (Bull. ex Fr.) Karsten. Why it was misdetermined is a mystery, but reports of C. cinnabarinus from as far south as Alabama should be discounted until verified by additional collections.

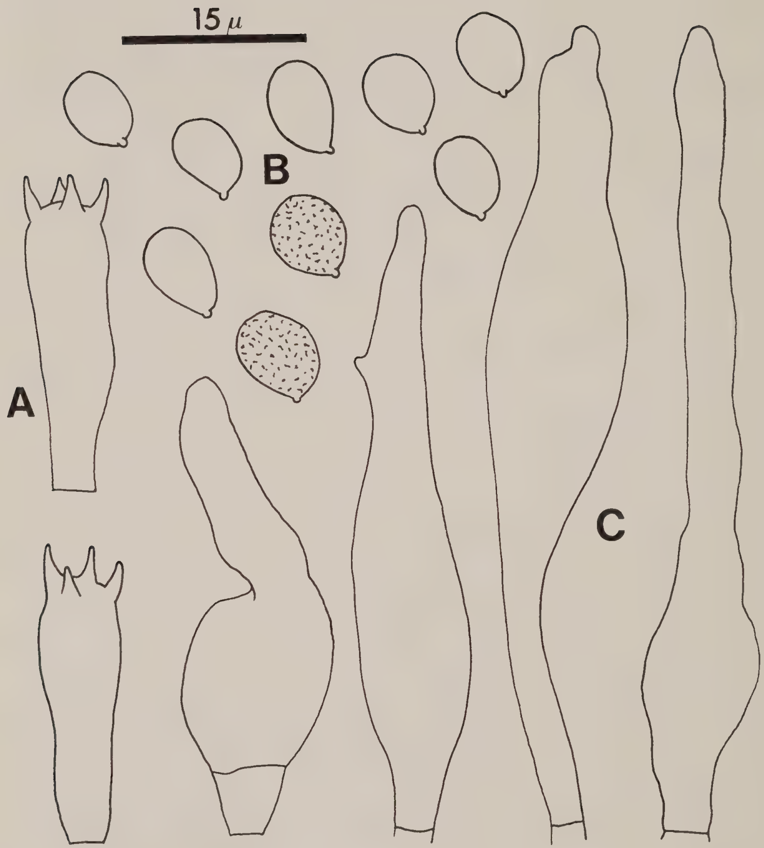


Fig. 3. Crepidotus cinnabarinus. A. Basidia. B. Spores. C. Cheilocystidia. DAOM 174971.

Finally, as can be seen in Figure 7, the geographic distribution of Crepidotus cinnabarinus in North America is continuous between the two type localities, clearly following that for the eastern deciduous forest and extending along the lower boreal forest where mixed Populus forests and grassland occur. Thus there is no reason to believe that the two type collections came from isolated geographic ranges.

The following is a description based on specimens examined:

Crepidotus cinnabarinus Peck, Bull. Torr. Bot. Club 22(12): 489. 1895. [!]

= Crepidotus cinnabarinus Møller & Westergaard in Møller, Friesia 3(2): 95. 1945.

= Crepidotus decurrens States, Bull. Torr. Bot. Club 99 (5): 250. 1972. [!]

Figures 1-7.

Pileus 2.2-18 mm wide, conchate to dimidiate, convex becoming nearly plane, opaque, when fresh "Scarlet Red" to "Spectrum Red", drying to ± "Dragon's Blood Red" or paler, tomentose, fibrillose to matted pubescent, dry; margin mostly even with incurved edges when young; context whitish except near the pellis; odor and taste not distinctive. Lamellae adnate to decurrent by minute teeth, becoming broad on larger basidiomes, moderately spaced, pallid-brown to honey colored on the faces when sporulating, becoming uniformly "Cinnamon Buff" to "Clay Color" to "Sayal Brown" or paler when dried, ± "Scarlet Red" on the edges when fresh and fimbriate-fringed; lamellulae in 1-2 tiers. Stipe plug-like or lacking, up to ± 2 X 1 mm, laterally attached, pubescent, concolorous with the pileus, or paler.

Pileipellis an interwoven layer of filamentous hyphae 4.5-6.5 µm diam., with smooth, thin walls, simple septa and reddish contents, giving rise to a loose trichodermium; trichoderm hyphae up to ± 240 (300) µm long, 3.2-7.2(8.0) µm diam., straight, twisted, bent or contorted, simple, smooth, thin-walled, simple-septate with usually 1-3 septa, mostly cylindric but apex sometimes cylindric-clavate; contents pale orange or pale orange-brown in KOH, especially so apically. Pileus trama somewhat duplex; hyphae loosely interwoven on the upper portion, compactly interwoven and with denser cytoplasmic contents below, thin-walled, smooth, simple-septate, often slightly inflated, 4-11 µm diam. Lamellar trama hyphae similar to the lower pileus trama hyphae, parallel to somewhat interwoven, thin-walled, smooth, simple-septate and often distinctly inflated, 5-25 µm diam.; subhymenial hyphae less inflated, interwoven. Pleurocystidia none. Cheilocystidia abundant, forming a distinct fringed sterile edge, 35-62 X (6)9-11.5 µm, fusoid to filamentous with a fusoid to ventricose base, sometimes with a long pedicel, rarely ± branched, often slightly undulating above, thin-walled, smooth, apex rounded to subacute; contents reddish. Basidia (17.6)20-23 X (6.1)6.4-7.2(8) µm, clavate, thin-walled, mostly 4-spored, lacking basal clamp, ± hyaline in KOH. Basidiospores 6.4-8.8(9.6) X 4.5-5.8(6.4) µm, obscurely obovoid to broadly ellipsoid, inequilateral in profile, usually tapering more towards the small apiculus than towards the distal end, thin-walled, appearing punctate to finely rugose under the light microscope (see previous for SEM studies), pale umber in mass as ± "Tawny Olive" or slightly darker.

Distribution: Canada: Alberta, Manitoba. United States: Illinois, Iowa, Michigan, Minnesota, New York, North Carolina, Ohio, Wisconsin. (Fig. 7) Denmark. USSR.

Substrates and Habitats: scattered on exposed or moss covered bark or decorticated fairly firm wood of (1) *Populus* spp., (2) *Fagus* sp., (3) *Tilia americana* L. and (4) *Ulmus americana* L. and unidentified hardwoods in the eastern deciduous forest or parkland-like prairie-boreal forest areas.

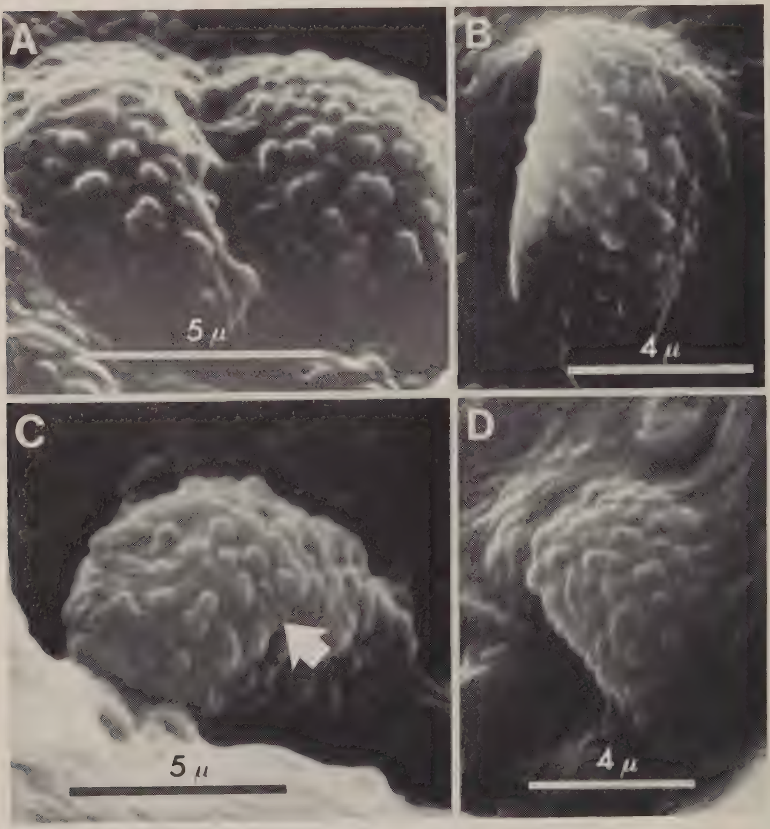
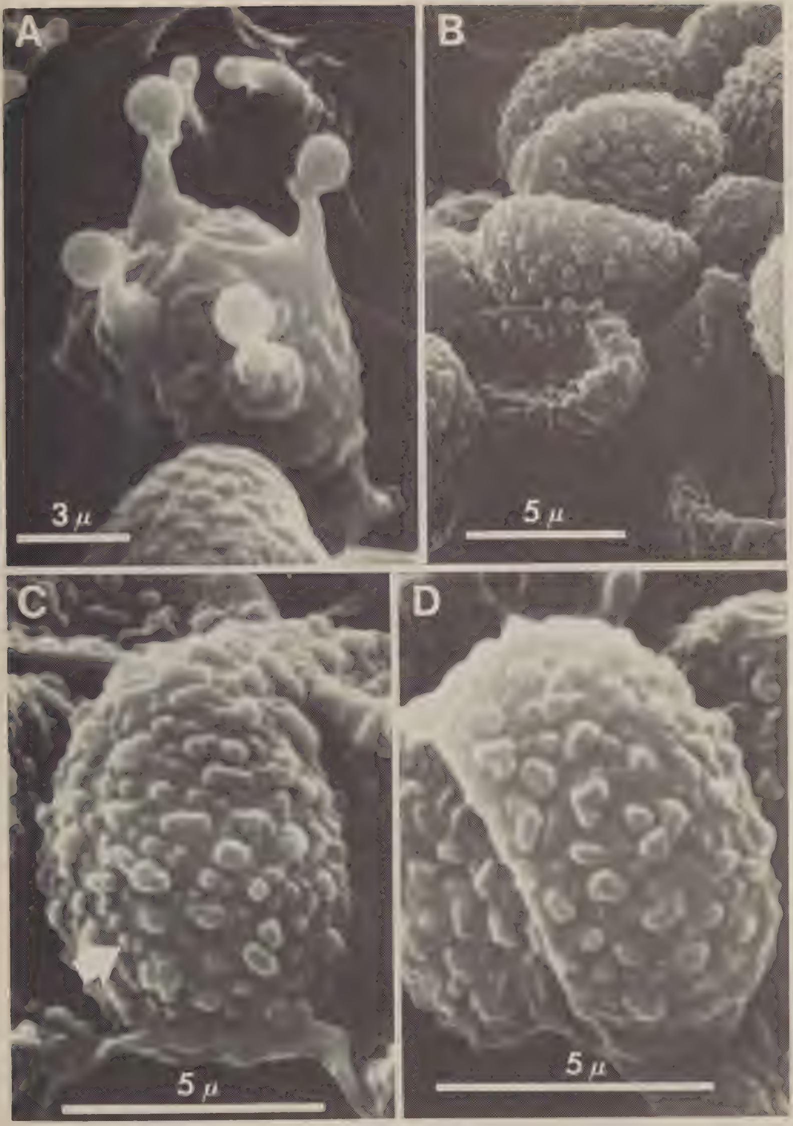


Fig. 4. *Crepidotus cinnabarinus*. A-D SEM view of basidiospores. For arrow see text. Holotype *C. cinnabarinus*.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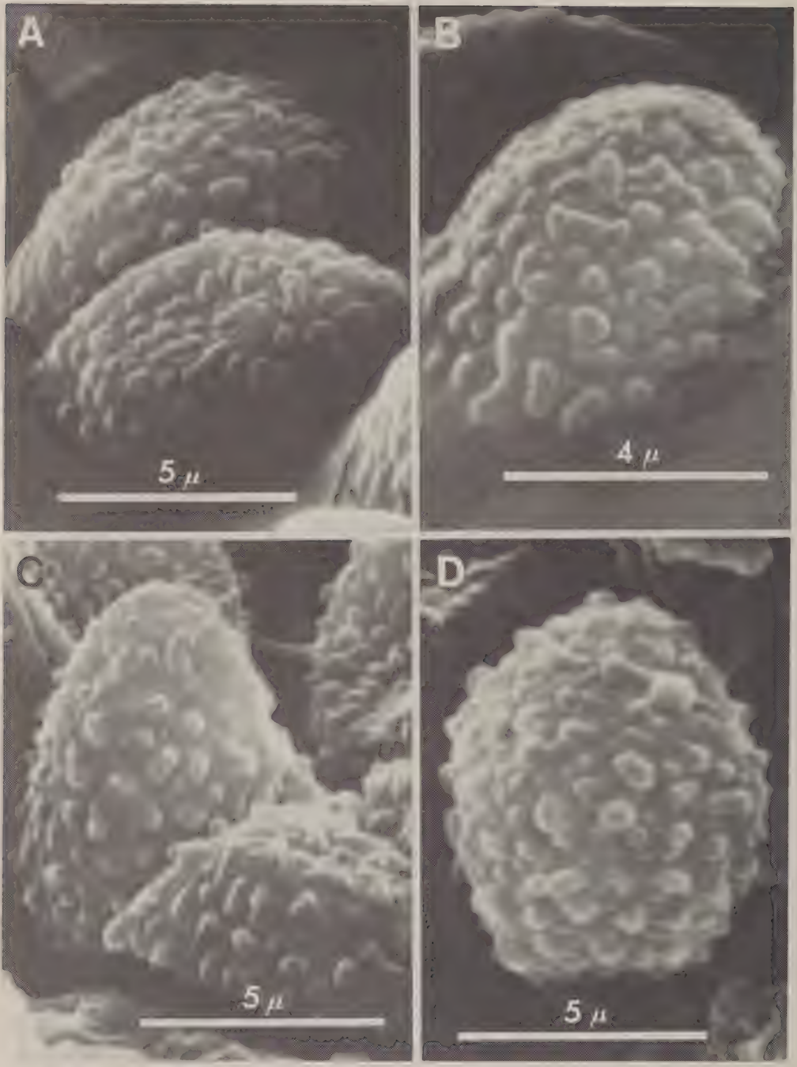
B
5 μ
C
5 μ
D
5 μ

Fig. 5. Crepidotus cinnabarinus. A. SEM view of basidium. B-D. SEM view of basidiospores. For arrow see text. Holotype C. decurrens.


A
5 µ
B
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C
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D
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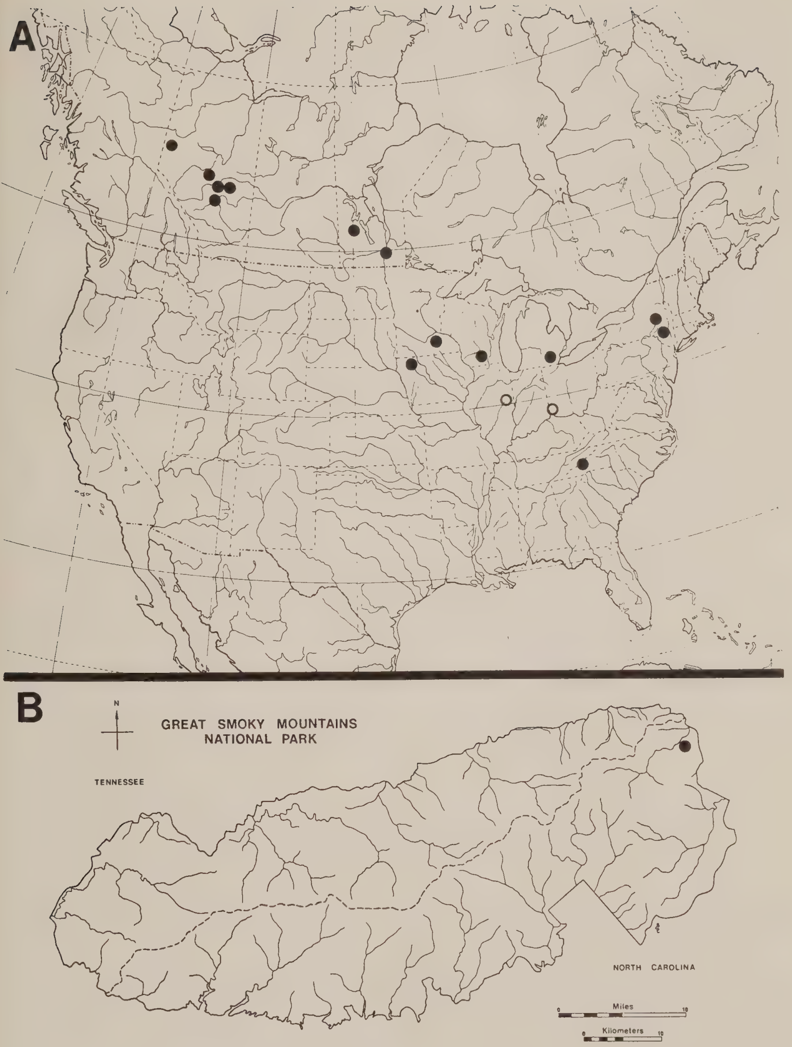
Fig. 6. Crepidotus cinnabarinus. SEM view of basidiospores. A-B. DAOM 170700. C-D. TENN 41923


A
B
N
GREAT SMOKY MOUNTAINS
NATIONAL PARK
TENNESSEE
NORTH CAROLINA
Miles
0
10
Kilometers
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10

Fig. 7. *Crepidotus cinnabarinus*. A. Distribution in North America. B. Southernmost collection site in the Great Smoky Mountains National Park. ● = verified with borrowed collections, ○ = not verified with collections or collections nonexistent.

Considering the confusion and inaccurate reports in the past regarding spore ornamentation, and how useful SEM studies were for helping to solve the present problem, we feel that a detailed SEM survey of N. American Crepidotus spores is warranted. Such a study would help provide the basis for a more natural infrageneric classification.

Specimens Examined

Canada

Alberta: Calmar, Aug. 10, 1968, J. States & D. Chomyn 777 (type of C. decurrens, ASC); Edmonton, Sept. 2, 1970, S. A. Redhead 138 (UBC); 20 mi. E. of Edmonton, Sept. 4, 1970, S. A. Redhead 159 (UBC, DAOM 161155); Elk Island Natl. Park near Edmonton, Aug. 6, 1971, on (1), J. A. Traquair (DAOM 174973); Sandy Lake, 50 mi. NW of Edmonton, Aug. 8, 1976, on (1), H. M. E. Schalkwyk 165 (DAOM 160985); same loc., July 29, 1977, H. M. E. Schalkwyk 553 (DAOM 170700); Buffalo Lake, Sept. 17, 1978, R. M. Danielson 2844 (DAOM 176623).

Manitoba: Winnipeg, July 19, 1927, G. R. Bisby & I. L. Conners (DAOM F-6955); same loc., July 22, 1927, G. R. Bisby & Newton (DAOM 155259); same loc., Sept. 20, 1927, W. L. Gordon et al. (DAOM 189430); same loc., Sept. 29, 1927, G. R. Bisby et al. (DAOM 152568); same loc., July 5, 1935, B. Peturson (DAOM 156610); Riding Mt. Natl. Park, Jackfish Cr. at Lake Audy, Aug. 22, 1979, on (1), J. E. & S. A. Redhead 2984 (DAOM 174971).

United States

Iowa: Milford, Aug. 4, 1933, G. W. Martin (NY); same loc., Aug. 7, 1933, L. W. Miller (NY).

Michigan: Ann Arbor, May 26, 1894, on (2), L. N. Johnson 1627 (NY); same loc., Sept. 24, 1894, L. N. Johnson (type of C. cinnabarinus, NYS, isotype MICH); same loc., Nov. 12, 1910, C. H. Kauffman (MICH); same loc., June 28, 1929, A. H. Smith (MICH).

Minnesota: Rice Co., Nerstrand Woods State Park, June 23, 1968, on (3), M. G. Weaver 1544 (MICH).

New York: Greene Co., edge of Catskill ("Kaaterskill"), mouth of Hillyer Ravine, Aug. 19, 1966, on (4), S. J. Smith 40510 & E. Blackman (NYS); Otsego Co., gorge N. of Cherry Valley, July 17, 1967, S. J. Smith 41656 & W. V. Glider (NYS); same loc., July 31, 1969, on (3), S. J. Smith 44405, W. V. Glider & D. J. Moore (NYS).

North Carolina: Great Smoky Mts. Natl. Park, Haywood Co., Big Cr. Area, Baxter Cr. Trail, Aug. 6, 1978, B. S. Luther 759 (TENN 41923); same loc., Sept. 24, 1978, B. S. Luther 812 (TENN 41924).

Wisconsin: Blue Mounds, Oct. 19, 1901, R. A. & A. M. Harper 176 (NYS); same loc., Aug. 8, 1903, on (3), E. T. & S. A. Harper (F 1316271).

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NOTES ON ARGENTINIAN LABOULBENIALES, WITH THE DESCRIPTION OF A NEW GENUS, BENJAMINELLA

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SUMMARY

Rickia platensis, R. pumila, R. perpusilla, and *R. melanophthalmae* constitute the genus *Benjaminella* gen. nov., characterized by the biseriate or triseriate receptacle (consisting of short cells), which bears sessile or subsessile phialides and lacks appendages opposite or below the perithecium (*Benjaminella melanophthalmae* [Thaxt.] comb. nov. [holotype], *B. perpusilla* [Speg.] comb. nov., *B. pumila* [Speg.] comb. nov., *B. platensis* [Speg.] comb. nov.). *Ecteinomyces perpusillus* is being transferred to *Aporomyces* (*Aporomyces perpusillus* [Speg.] comb. nov.) because of its prominent, persistent, terminal trichogyne base (which rises above the apical outer wall cells of the perithecium and through which the ascospores are discharged) and the poorly developed basal cells of its perithecium. *Ecteinomyces pusillimus* is being transferred to *Siemaszkoa* (*Siemaszkoa pusillima* [Speg.] comb. nov.) because its appendage is simple and the outer wall of its perithecium consists of 3 vertical rows of 3 cells each and 1 row of 4 cells; the cell walls of the perithecial basal cells are indistinct at maturity.

Partly because of the large quantity of Argentinian fungi that had been accumulated by Carlos Spegazzini, Roland Thaxter travelled to South America in 1905-6 during his sabbatical year. While in Argentina and Chile he collected large numbers of fungi, including Laboulbeniales. His interest in these insect parasites, in turn, inspired Spegazzini to study this order. Publications by both men on the Argentinian taxa appeared in 1912. Thaxter had collected in a number of the localities in which Spegazzini obtained the majority of his specimens--these areas were all near Buenos Aires and La Plata. In his later publication (1917) Spegazzini added other taxa which he had collected from this region, as well as a few that had been obtained from Neuquén Province in the forested area around Lake Nahuel-huapí and some (mostly *Laboulbenia* species) from other parts of the country. Even though the area that was intensively surveyed was small, the number of families of hosts (belonging mostly to the Coleoptera, but also to the Acarina, Blattaria, Dermaptera, Diptera, Hemiptera [Corixidae and Veliidae], and Hymenoptera [Formicoidea]) was quite large. However, there is a need for additional collections of some of these families for clarification of the identity of the fungus parasites--for example, Catopidae and Pselaphidae. Other families of Coleoptera that should be examined are Leiodidae and Histeridae, as well as the five families in the Cucujoidea (Corylophidae, Cryptophagidae, Lathridiidae, Phalacridae, and Rhizophagidae) on which species of *Benjaminella* have been found.

BENJAMINELLA GEN. NOV.

Although Thaxter described nine new genera in 1912, he placed one new species in the genus *Rickia* (*R. melanophthalmae*) even though there was no indication of the distinctive appendages subtended by thick, constricted, black septa that are characteristic of that genus (in Thaxter's material, all of the primary appendages appear to have broken off). In October, 1915, Spegazzini obtained from the same place--the Escuela Regional de Santa Catalina, near Llavallol (a few miles south of Buenos Aires and now a suburb)--three additional taxa which were quite similar in appearance, but which occurred on different families of beetles, although they probably occupied similar habitats. Spegazzini described these species as *Rickia* (1917), even though there were no constricted black septa on the well-developed thalli. In the last volume of his monograph, Thaxter (1931) pointed out that these four closely related species of *Rickia* should be removed from the genus. I now take the opportunity of placing these species in a new genus named for Dr. Richard K. Benjamin, who has devoted many years to the study of the Laboulbeniales and who one might say has followed faithfully in Thaxter's footsteps, both in his intensive collecting and in his artistic abilities.

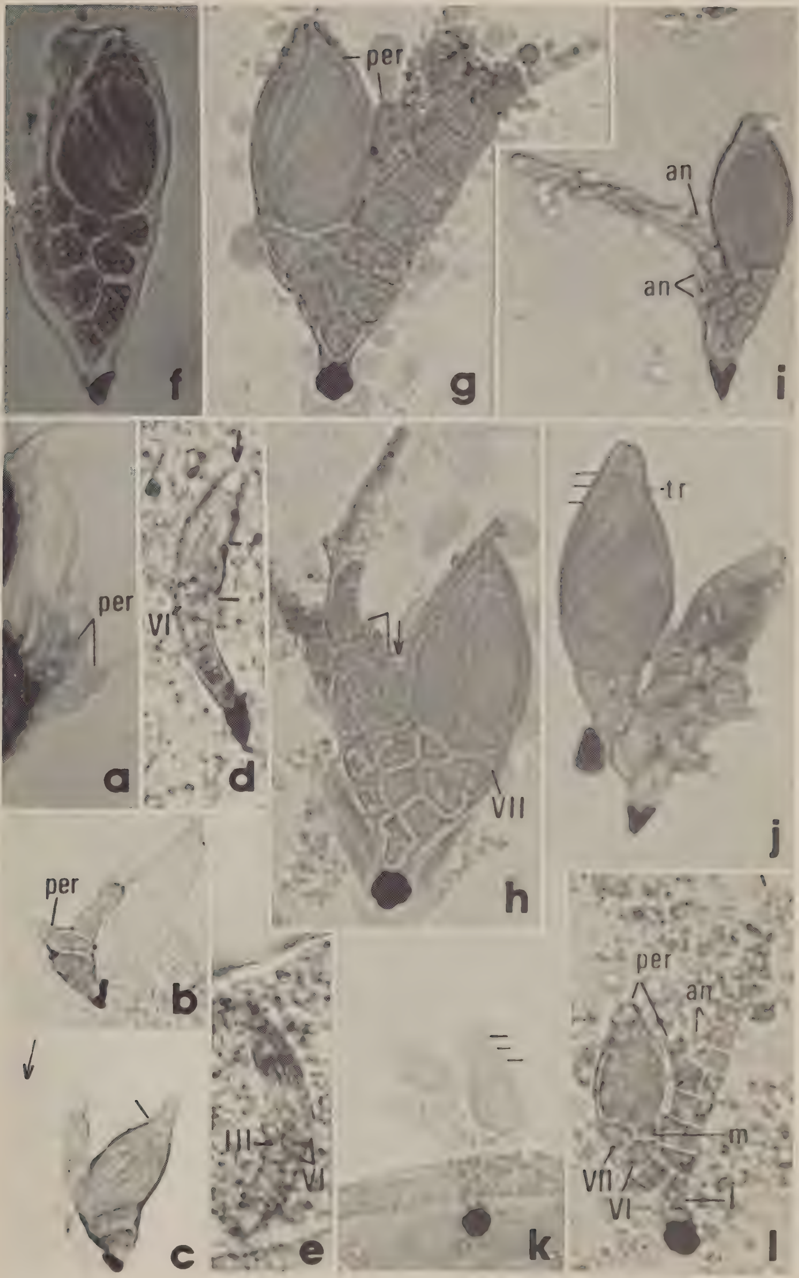
Benjaminella gen. nov. Paries perithecii exterior ex quattuor seriebus cellularum horizontalibus altitudine inaequis constans; receptaculum multicellulare, biseriatum vel triseriatum; antheridia sunt phialides in margine exterior receptaculi partim inclusae; septa constricta nigra nulla.

Receptacle multicellular, composed of short, more or less cubical, rhomboidal, or rounded cells arranged in two or three vertical rows, which may extend some distance above the base of the perithecium. Simple primary appendage terminates primary axis; there may be some short lateral appendages on the primary axis above the perithecium. Antheridia are sessile or subsessile phialides with slightly protruding necks; they may be borne either above the perithecium on the anterior side of the upper receptacle (facing the perithecium) or on the posterior side of the lower receptacle opposite the perithecium. There are no appendages bearing constricted black septa like those occurring in *Rickia*. Outer wall of perithecium consists of 4 vertical rows of 4 cells each, the 3 upper cells being much shorter than the lower cell in each row.

Holotype: *Benjaminella melanophthalmae* (Thaxt.) comb. nov. Basionym: *Rickia melanophthalmae* Thaxter, 1912, p. 161, on elytra of *Melanophthalma* sp. (Lathridiidae). Escuela Regional de Santa Catalina, south of Buenos Aires, Argentina, April, 1906 (Thaxter no. 1980).

Benjaminella differs from *Homaromyces* and *Amphimyces* by its bi- or triseriate receptacle and from *Rhipidiomyces* by the shape of its receptacle cells (in *Homaromyces* and *Amphimyces* the receptacle is multiseriate and bears appendages; the fan-shaped receptacle of *Rhipidiomyces* is composed of narrow, vertically elongate cells). Sessile or subsessile phialides are borne along the receptacle margin in all of these genera (possibly excepting *Amphimyces*). *Asaphomyces* and *Dermapteromyces* differ in the greater height of the perithecium with respect to its width; as in *Benjaminella* and *Amphimyces*, the lowest cell in each vertical row of outer perithecial wall cells is much taller than any of the three upper cells. In *Asaphomyces* only one cell is visible above cell *VI* at the base of the mature perithecium.

Plate I. Figs. a-c. *Aporomyces perpusillus* (slide 242). X 720. a. Pair of young perithecia-bearing thalli borne on antenna. b. Thallus with young perithecium; narrow upper part of primary appendage extends from broader, lower part. c. Mature thallus; narrow termination of primary appendage has broken off; narrow extension (arrow) apparently is not attached to appendage; inner wall cells visible at the upper limits of outer wall cells (line) just below persistent trichogyne base (*tr*); ascospores occupy base of perithecium, obscuring remnants of perithecial basal cells. Figs. d-e. *Siemaszkoa pusillima*. X 760. d. Mature thallus showing protruding apical cell of perithecium (arrow); stalk cell of perithecium (*VI*) is at left; lines at right indicate extent of primary appendage, which has broken off. e. Mature thallus with cell *VI* at right (v-line) and cell *III* (upper receptacle cell) at left; primary appendage has broken off; elongate spores are visible inside perithecium. Fig. f. *Benjaminella melanophthalmae* (slide 2976); arrow points to neck of subsessile phialide; upper 3 tiers of outer wall cells clearly visible. Figs. g-h. *Benjaminella platensis* (type slide). X 720. g. Mature thallus with 2 perithecia; short appendages are present just above young perithecium; apex of primary appendage visible at right. h. Lectotype; 2-3 cells, which are probably phialides, are present (v-line); arrow points to unicellular incipient perithecium; cell *VII* (secondary stalk cell) is in the normal outer position; appendage extending upward is probably primary appendage. Figs. i-j. *Benjaminella perpusilla*. i. Submature thallus; phialide is present just above perithecium; 2 phialides (*an*) are on lower receptacle. X 720. j. Mature thallus with 2 perithecia; lines indicate septa in outer walls; trichogyne stump visible at right (*tr*). X 760. Figs. k-l. *Benjaminella pumila*. k. Thallus with 2 fully developed perithecia. X 560. l. Thallus with 1 young perithecium above the submature primary perithecium; 2 phialides are above perithecia; cells *m* (one of perithecial basal cells) and *I* (basal cell of thallus) are indicated (line at upper right points to apex of appendage). X 760.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The four species of *Benjaminella* and their characteristics are as follows:

Benjaminella melanophthalmae. Specimens examined: FH 2975-6; Benjamin collection: on *Cryptophagus* (Cryptophagidae), Sublette Co., Wyoming (11 mi. SE of Bondurant on Routes 187-189 at 7300 feet in aspen litter, C. C. Hoff, 7 Aug. 1959 [R. K. Benjamin 2467]), which belongs to this taxon, although the primary axis bends sharply outward like that of *B. perpusilla*. The ovoid perithecium is similar to that of *B. platensis* (pl. I, fig. f); cell *m* is laterally adnate to the receptacle (like those of *B. platensis* and *B. pumila*, the receptacle is triseriate across the base when sufficiently mature), which extends only a short distance above the basal cells of the perithecium before it narrows abruptly. In the Wyoming specimens, the narrow upper portion of the primary axis bends sharply outward just above the base of the perithecium; in the type collection the primary axes are broken off at this point (there is no evidence of their turning outward). This species differs from *B. platensis* by the presence of antheridia on the lower receptacle in normal thalli at maturity and by the absence of an elongate, biseriate upper receptacle bearing phialides and a secondary perithecium (the Wyoming specimens bear a phialide just above the perithecium). Thaxter's measurements (1912) were: perithecium 35-43 µm tall, 23 µm wide; receptacle 40 µm tall, 27-31 µm wide; total height 75-85 µm (the Wyoming collection includes smaller mature thalli ca. 50-65 µm tall).

Benjaminella perpusilla (Speg.) comb. nov. Basionym: *Rickia perpusilla* Spegazzini, 1917, p. 666, on elytra of *Phalacrus* sp.? (Phalacridae). Escuela Regional de Santa Catalina and La Plata, winter, 1915. Specimens examined: LPS 38700 (Inst. Bot. Speg., La Plata; October, 1915, Santa Catalina)(slide 367-1915). Perithecium obpyriform, as in *B. pumila*, but neck may be less distinct; cell *m* tends to be free laterally from the receptacle, which narrows just above the base of the perithecium, although a secondary perithecium may develop (presumably because the primary perithecium has aborted)(pl. I, fig. j); on thalli bearing only a primary perithecium, subsessile phialides are present on young thalli along the posterior margin of the lower receptacle (pl. I, fig. i) and sessile phialides may occur above the perithecium. Spegazzini's measurements were: perithecium 30-35 µm tall, 13-14 µm wide; height to apex of perithecium 60-70 µm; thallus width 10-11 µm; total height 75-90 µm.

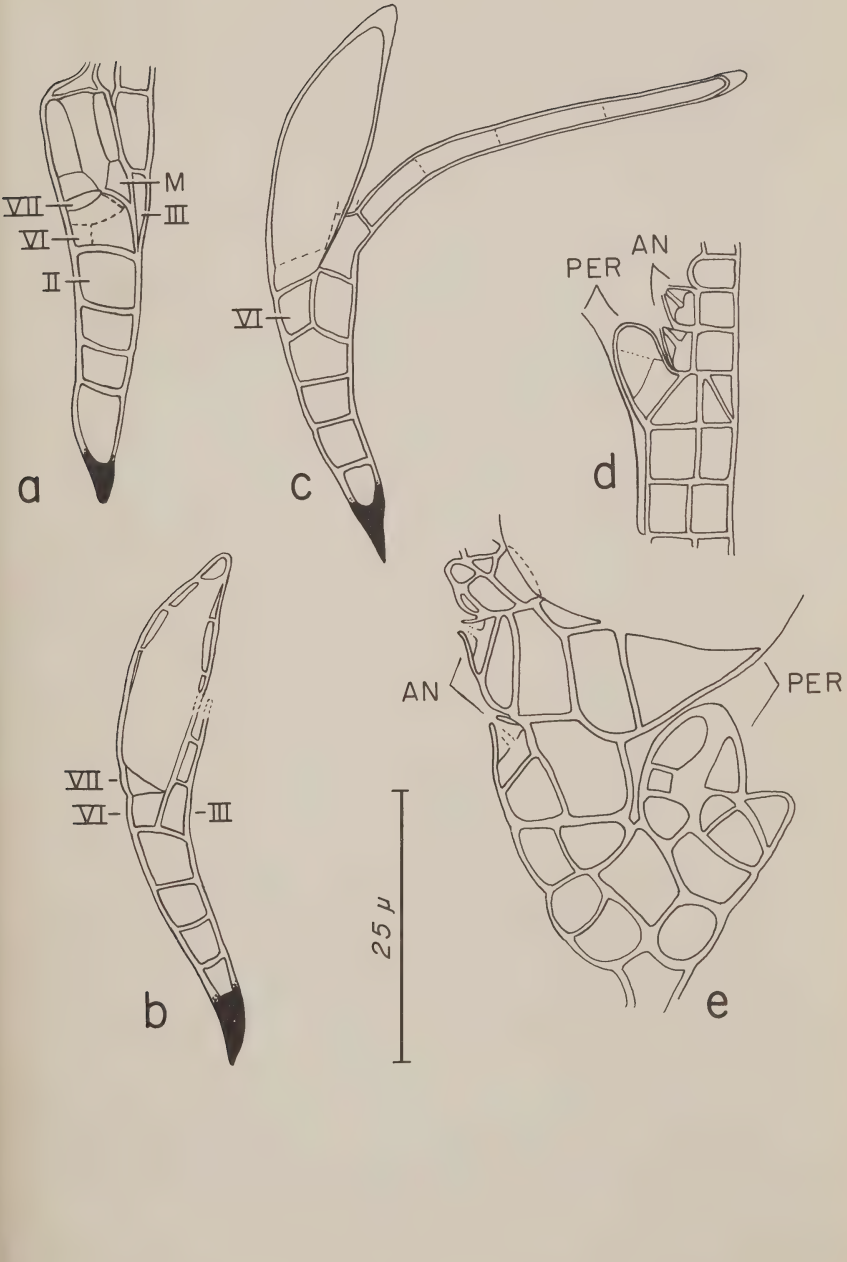
Benjaminella platensis (Speg.) comb. nov. Basionym: *Rickia platensis* Spegazzini, 1917, p. 667. On elytra of *Europs vicinus* Grouvelle (Rhizophagidae, subfamily Monotominae, which is sometimes put in the Cucujidae), Escuela Regional de Santa Catalina, 3 October, 1915. Specimens examined: LPS 38701-2. The ovoid perithecium is very broad at the base and tapers evenly to the narrow apex; the perithecial basal cell *m* is laterally adnate to the receptacle; the broad, biseriate primary axis extends half the height of the primary (lower) perithecium before it narrows--it terminates in a uniseriate primary appendage, which usually breaks off; phialides are formed on the cells above the secondary perithecium, which arises just above the first (pl. I, fig. h) or which may be separated from the primary perithecium by a tier of cells (pl. I, fig. g). Under unusual circumstances mature thalli may bear phialides on the posterior margin of the lower receptacle--for example, in the thallus shown in pl. II, fig. e, in which the primary perithecium aborted and a mature secondary perithecium is present. The thallus of *B. platensis* is large in size--Spegazzini's measurements were: perithecium 40-50 µm tall, 22-25 µm wide; height to apex of perithecium 70-80 µm; thallus width 32-35 µm; total height 70-100 µm.

Benjaminella pumila (Speg.) comb. nov. Basionym: *Rickia pumila* Spegazzini, 1917, p. 668, on elytra of *Sacium* sp. ? (Corylophidae). Escuela Regional de Santa Catalina, October, 1915. Specimens examined: LPS 38699 (no. 370-1915). Similar in appearance to *B. platensis* but much smaller (pl. I, figs. k,l); perithecium obpyriform, having a distinct neck; cell *m* may not be laterally adnate in younger thalli (compare pl. II, fig. d with pl. I, fig. l). Spegazzini's measurements were: perithecium 22-25 µm tall, 13-15 µm wide; height to perithecial apex 48-52 µm; thallus width 20-22 µm; total height 75-85 µm.

A single ascogenic cell is present in the perithecium in *Benjaminella*; the inner wall cells apparently arise from the basal cells of the perithecium. Observations on a young thallus of *B. pumila* showed that at first the thallus is uniseriate. The receptacle cells divide by horizontal divisions, their septa becoming constricted. Superposed upon a series of several inflated cells are some short, uninflated cells that probably are primary appendage cells, although the lowest cubical cell might represent cell *III*. Later, vertical divisions occur in the receptacle cells. In a young specimen of *B. melanophthalmae* from Wyoming, a short, broad cell lay between the spore septum and the upper receptacle cell producing the phialide; the slender primary appendage was two-celled. From the appearance of the cells at the posterior margin in all of the species, it seems probable that spermatia might sometimes be formed in young thalli opposite the perithecium and evidence of their presence be obliterated later. In some thalli (for example, that shown in pl. I, fig. h) it is possible that posterior phialides have been formed early in development; after spermatium discharge ceased, the phialide protoplast may have extended outward, obliterating the neck. The phialide protoplast subsequently could divide obliquely, the upper, outer cell again having the capability of functioning as a phialide. The extent to which this proposed sequence might be initiated and continued probably would depend on the species and on the circumstances of development. It is possible that posterior phialides are limited only to those taxa in which the upper receptacle narrows quickly; however, it is essential that young stages of all taxa be studied in order to determine the manner of development. If thalli having only posterior phialides are self-fertile, one would expect a long trichogyne to extend across the receptacle. Short trichogynes extend to the upper, anterior phialides in the Wyoming thalli of *B. melanophthalmae*; possibly the posterior phialides function in cross-fertilization.

It would be desirable to find out if additional host groups are parasitized by *Benjaminella* to the north along the Paraná River in Argentina. Beetles and possibly also mites frequenting leaf mold or decaying branches may harbor this genus. Cross-inoculation experiments should be made

Plate II. Figs. a-c. *Siemaszkoa pusillima*. a. Thallus having perithecium in 1-tiered stage; inner walls not detected; cells *VII* and *III* partially lie under the large cell *VI*. b. Mature thallus, showing protruding apical cell of perithecium. c. Mature thallus; branch from lowermost cell of primary appendage has broken off (possibly a phialide was borne in this position when the perithecium was immature). d. *Benjaminella pumila*. Phialides (*an*) and young perithecium of thallus shown in pl. I, fig. 1. e. *Benjaminella platensis* (type slide); thallus in which primary perithecium has aborted and secondary perithecium is fully developed; two phialides are on posterior side of lower receptacle.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to determine whether the taxa will grow on hosts in different families and what, if any, effect the identity of the host has on the morphology of the fungus species. In particular, the question might be asked whether *B. platensis*, when germinated on *Melanophthalma*, might grow less extensively than it does on *Europs* and retain posterior phialides, which may be a juvenile characteristic.

SIEMASZKOA AND *APOROMYCES*

One of the habitats that was investigated by Spegazzini was the nests of the leaf-cutting, fungus-growing ant *Acromyrmex lundi* (Guérin-Méneville), which is one of the most important ants in southern South America from an economic standpoint, according to Weber (1972). The following species were described by Spegazzini in 1917 from beetles found in these nests: *Pselaphidomyces pselapti* (a new genus) on *Pselaptus tuberculifer* Raffray (Pselaphidae), La Plata; *Stigmatomyces urophilus* on *Heterothops formicetorum* Bernhauer (Staphylinidae, Staphylininae), Escuela Regional de Santa Catalina, Florencio Varela (southeast of Buenos Aires), and La Plata; *Corethromyces scydmaenicola* on an unidentified scydmaenid, La Plata (the latter two taxa will be dealt with in a subsequent publication); *Ecteinomyces perpusillus* on *Rhopalopherus gestroi* Bernhauer (as *Rhopalophorus*)(Staphylinidae, Oxytelinae), Florencio Varela, La Plata, and Escuela Regional de Santa Catalina; and *Ecteinomyces pusillimus* on an unidentified ptiliid, Escuela Regional de Santa Catalina and La Plata (it is possible that this host was *Limulodes elongatus* Bruch [Physis 7: 227-231. 1924], which was described from a nest of this ant).

The latter two species were undoubtedly placed in *Ecteinomyces* because of the uniseriate receptacle consisting of at least 3 cells below the perithecium. Thaxter had not yet described the genera *Phaulomyces, Meionomyces, Euphoriomyces,* and *Carpophoromyces*, all of which, like *Siemaszkoa* (Tavares and Majewski, 1976), have perithecia with basal cells that remain thin-walled (and thus are indistinct at maturity) and with only 3 cells in 3 vertical rows of outer wall cells and 4 in the fourth row. Neither had he described *Aporomyces*, which also has poorly defined perithecial basal cells, as well as a protruding, persistent, apical trichogyne base and a primary appendage that appears to emerge from the side of the mature perithecium (pl. I, figs. b,c)(these genera were described by Thaxter in 1931).

Aporomyces perpusillus (Speg.) comb. nov. (basionym: *Ecteinomyces perpusillus* Spegazzini, 1917, p. 543) was reported to occur on the apical annulations of the antennae of *Rhopalophorus gestroi*; the correct genus name is *Rhopalopherus* (see Blackwelder, 1944-57). The original misspelling led to Thaxter's error in listing the host as a member of the Cerambycidae; he also erred in listing the host genus as *Rhopalocera* when he apparently meant *Rhopalophora* (see note, Benjamin, 1971). Specimens examined: LPS 38635-6 (type collection, presumably from La Plata; slide 210, 1915 [type]; 242, June, 1915). Spegazzini's measurements: total height, 60-65 µm; perithecium 45-48 µm X 17-18 µm; receptacle 18-20 µm high, 10-12 µm wide; appendage 25 µm X 5 um. The perithecia are somewhat smaller than those of *Aporomyces szaboi* Bánhegyi (1944)(50-58 X 29-34 µm), but they are close to the size of those of the three species described by Thaxter in 1931, although those of *A. trinitatis* Thaxt. are wider. All of the species except *A. perpusillus* are probably dioecious, a minute male being paired with the female. By contrast, many perithecium-bearing thalli grew in pairs in Spegazzini's material (pl. I, fig. a). No antheridia were observed; Spegazzini (1917) indicated a long, narrow structure on the primary axis cell just above the base of the perithecium that presumably was considered to be either an antheridium or an antheridial neck. However, I did not observe such a structure on the thalli examined (note the position of the narrow "outgrowth" in pl. I, fig. c [arrow]). It should be determined whether intercalary cells of the primary axis above the perithecium function as phialides for a brief period or whether a narrow phialide terminates the primary appendage. There appear to be 3 outer wall cells in each vertical row and 2 tiers of inner wall cells enclosed within the neck just below the persistent trichogyne base terminating the perithecium (pl. I, fig. c); possibly the inner wall cells arise from the lowest tier of outer wall cells. There is one ascogenic cell.

Siemaszkoa pusillima (Speg.) comb. nov. (basionym: *Ecteinomyces pusillimus* Spegazzini, 1917, p. 545) was reported to occur on the elytra of an unidentified trichopterid (Ptiliidae). Specimens examined: LPS 38973 (presumably type collection and from La Plata [slide 319-1915]). Spegazzini's measurements: perithecium 35 µm tall, 12-13 µm wide, receptacle 30 µm tall, 5-7 µm wide, appendage 40-45 µm tall, 2-3 µm wide. This taxon is similar to *S. ptenidii* (Scheloske) I. Tavares & Majewski, but it is smaller (in error, perithecial length in *S. ptenidii* was given as 120 µm rather than 59 µm by Tavares and Majewski in 1976). In both species the 4-celled outer wall cell row (pl. II, fig. b) is on the anterior (outer) side of the perithecium.

Siemaszkoa ptenidii occurs on *Ptenidium* (Ptiliidae) in Europe (Tavares and Majewski, 1976). The secondary stalk cell of the perithecium (cell *VII*) is in the normal anterior position in *S. pusillima* (pl. II, fig. a). Spegazzini (1917) reported that antheridia are formed on the anterior side of the appendage cells; possibly a phialide was produced by the first appendage cell in the thallus shown in pl. II, fig. c. There is one ascogenic cell in *S. pusillima*. The appendage, which bends outward (pl. II, fig. c), is usually broken off (pl. I, figs. d,e)(the appendage in *S. ptenidii* is erect).

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PHOMA CYANEA SP. NOV. FROM WHEAT DEBRIS

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An unusual *Phoma* species which produces a rather exceptional blue colour in the agar was isolated from wheat field debris. This was found to be a stable characteristic after several subcultures and unique among *Phoma* species.

Phoma cyanea sp. nov.

Coloniae in agaro farinae avenaceae moderatae crescentes, ad 25°C septum diebus 60 mm attingentes. Mycelium elevatum gossypinum floccosum, griseum ad cyaneum atro-cyanescens, coloniae reversus atro-cyaneus.

Hyphae laeves ad verruculosae, septatae, ramosae, clarae, hyalinae vel dilutae cyaneae ad atro-cyaneae, saepe incrustatae cristallis cyaneis, flexuosae, 2,5-7,5 μm diam. Hyphae vestustiores crassae saepe septis constrictae.

Pycnidia superficialia, 100-300 μm diam, laevia, globosa ad subglobosa subinde ellipsoidalia, cyanea ad atro-cyanea, collo brevi, ostiole colloratum uno collo praeditum, paries pycnidialis 12,5-19,0 μm crassi, ex 1-2 stratis cellularum parenchymatarum formata. Cellulae conidiogenae (phialides) hyalinae, globosae ad subglobosae vel irregulares, 3,75-6,25 x 5,0-7,5 μm, collo 1,0-2,0 x 1,0 μm. Conidia hyalina, continua, laevia, albida in toto, rectae vel moderate curvata, oblonga ellipsoidalia, fusiformia vel subinde clavata, 5,0-10,0 x 1,8-4,0 μm.

Chlamydosporae ubi immaturae globosae ad subglobosae, atro-cyaneae, numero cellularum variabilis, cellulae individuae 10-0-21,0 x 10,0-12,5 µm, parietis crassiusculae.

Habitat: In foeno tritici, Heilbron, Africa australis.

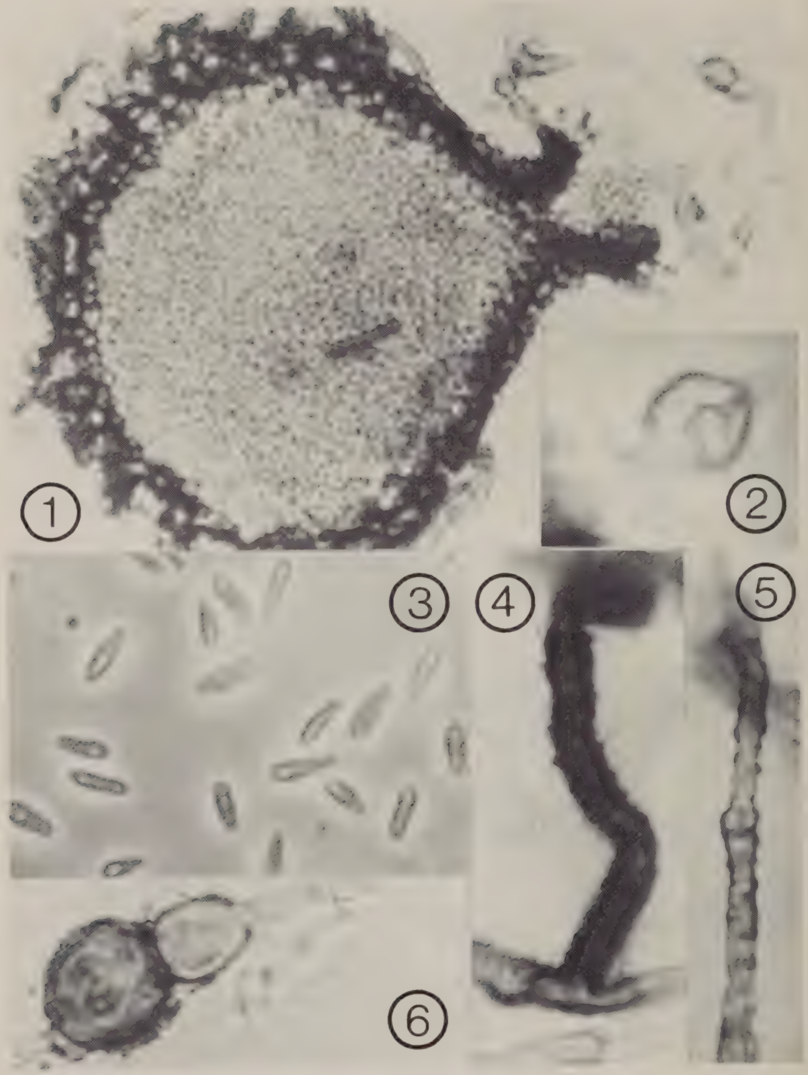
Holotypus: Cultura siccata PREM numero 45736.

The colonies grow moderately fast on oatmeal agar, reaching a diameter of 60 mm in 7 days at 25°C. The mycelium is raised, cottony, floccose, grey to cyan blue (1), becoming dark cyan blue.

The pycnidia are superficial, 100-300 µm in diameter, smooth, globose to subglobose or occasionally ellipsoidal, cyan blue to very dark cyan blue, usually with a single ostiole in a short neck with a collarette (Fig.1). The pycnidial wall is 12,5-10,0 µm thick and consists of 1-2 layers of parenchymatous cells. The conidiogenous cells (Fig.2) are hyaline, amphygnous, globose to subglobose or irregularly shaped phialides, 3,75-6,25 x 5,0-7,5 µm with a neck of 1,0-2,0 x 1,0 µm. The conidia (Fig.3) are hyaline and whitish in mass, continuous, smooth straight or moderately curved, oblong ellipsoidal or obovoid, occasionally clavate, 5,0-10,0 x 1,8-4,0 µm with a length:width ratio of 2,7:1.

The hyphae are septate, branched, flexuous, bright, hyaline or light to dark cyan blue, 2,5-7,5 µm in diameter, occasionally encrusted in cyan blue cristals (Fig.4) or smooth to verruculose (Fig.5). Older hyphae are often constricted at the septa.

The chlamydospores are dark cyan blue, with individual cells globose to subglobose, intercalary or terminal with somewhat thick walls encrusted in blue crystals (Fig.6). In older cultures dictyochlamydospores are common, they are intercalary or terminal on branched hyphae (Fig.7); the number of cells are variable and the individual cells are 10,0-21,0 x 10,0-12,5 µm.



Figures 1-6. *Phoma cyanea*. Fig.1. Section through pycnidium showing 1-2 cell wall layers and short neck (X720). Fig.2. Single globose phialide (X3600). Fig.3. Conidia (X1400). Fig.4. Encrusted hypha (X1400). Fig.6. Chlamydospore (1400).

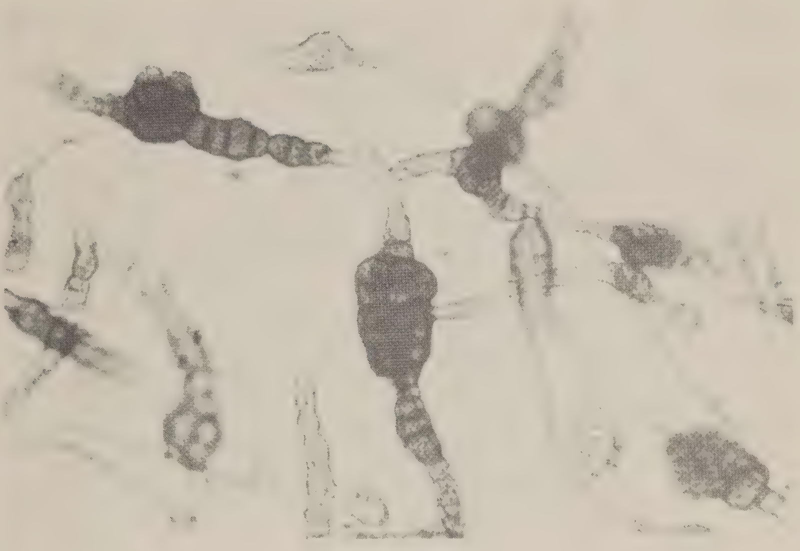


Figure 7. *Phoma cyanea*. Intercalary and terminal dictyoclamydospores (X770).

The specific epithet of this fungus is derived from the cyan blue colour of the hyphae, pycnidia and chlamydospores. This colouring is also the main diagnostic feature. However, the globose pycnidia with the short neck and collarettė as well as the distinctive arrangement of the dictyochlamydospores, are valuable diagnostic characters.

Living cultures of the fungus have been deposited at the Centraal Bureau voor Schimmelcultures, Baarn, The Netherlands, no. CBS 388.80 and in the Potchefstroom University Culture Collection no. 1307. The holotype is deposited as a dried culture in the Mycological Herbarium (PREM) of the Plant Protection Research Institute, Private Bag, X134, Pretoria, 0001.

ACKNOWLEDGEMENTS

We thank the C.S.I.R. Pretoria and South African Department of Agriculture and Fisheries for financial assistance, Dr. H.A. van der Aa of the Centraal Bureau voor Schimmelcultures, Baarn, for assistance in determining the uniqueness of this fungus, dr. H.W. Simpson for assistance with the latin diagnosis and Dr. G.C.A. van der Westhuizen for reading the manuscript.

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PHAEOTHECA AND *PHAEOSCLERA*, TWO NEW GENERA OF DEMATIACEOUS HYPHOMYCETES AND A REDESCRIPTION OF *SARCINOMYCES* LINDNER

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ABSTRACT

Recently, we examined several dematiaceous, sclerotic fungi which displayed remarkable similarity in their appearance on the host and in culture, yet differed considerably in their conidium ontogeny. A new genus, *Phaeotheca*, is described for an isolate which produces sporangium-like mother cells containing one to several endoconidia. *Sarcinomyces* Lindner is redescribed for two isolates which form blastic conidia from multicellular sclerotic bodies. Fungi which develop only bulbil-like masses of sclerotic cells by conversion of short strands of hyphae are included in the new genus *Phaeosclera*.

INTRODUCTION

While examining a canker of *Cronartium coleosporioides* on lodgepole pine, *Pinus contorta*, one of us (A.T.) noticed numerous small colonies of a dematiaceous fungus among the aeciospores and nearby on the bark of the tree. From the canker, we isolated a black, slow-growing, sclerotic fungus which later produced sporangium-like mother cells with one to a few endoconidia. Since we observed no gametangia or evidence of sexual reproduction, we describe this fungus as a new form-genus of the Hyphomycetes, *Phaeotheca*.

Subsequently, we found another dematiaceous, sclerotic fungus on rust galls caused by *Endocronartium*.

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On the host and in culture, this new isolate appeared remarkably similar to *Phaeotheca*, but it produced filiform blastic conidia from multicellular sclerotic bodies. It is identified as *Sarcinomyces* Lindner.

These fungi were compared with two other isolates from the culture collection of the Northern Forest Research Centre, Edmonton, which also appeared similar in culture. However, they produced only bulbil-like masses of sclerotic cells by conversion of short hyphal strands. They are described in the new genus *Phaeosclera.*

MATERIAL AND METHODS

Specimens and cultures: Type specimens are deposited in the UAMH. Subcultures from the type strains have also been sent to the American Type Culture Collection, the Commonwealth Mycological Institute and the Centraalbureau voor Schimmelcultures. Duplicates of dried colonies prepared from the type cultures are deposited in the National Mycological Herbarium, Ottawa, Canada and the CMI.

Microscopy: Critical-point drying was used to prepare most of the specimens for scanning electron microscopy. However, *Sarcinomyces crustaceus* was air-dried after fixation with osmium vapour to prevent conidia from detaching. Detailed procedures for fixation and dehydration of materials were the same as those described previously (Tsuneda and Hiratsuka, 1979).

TAXONOMIC PART

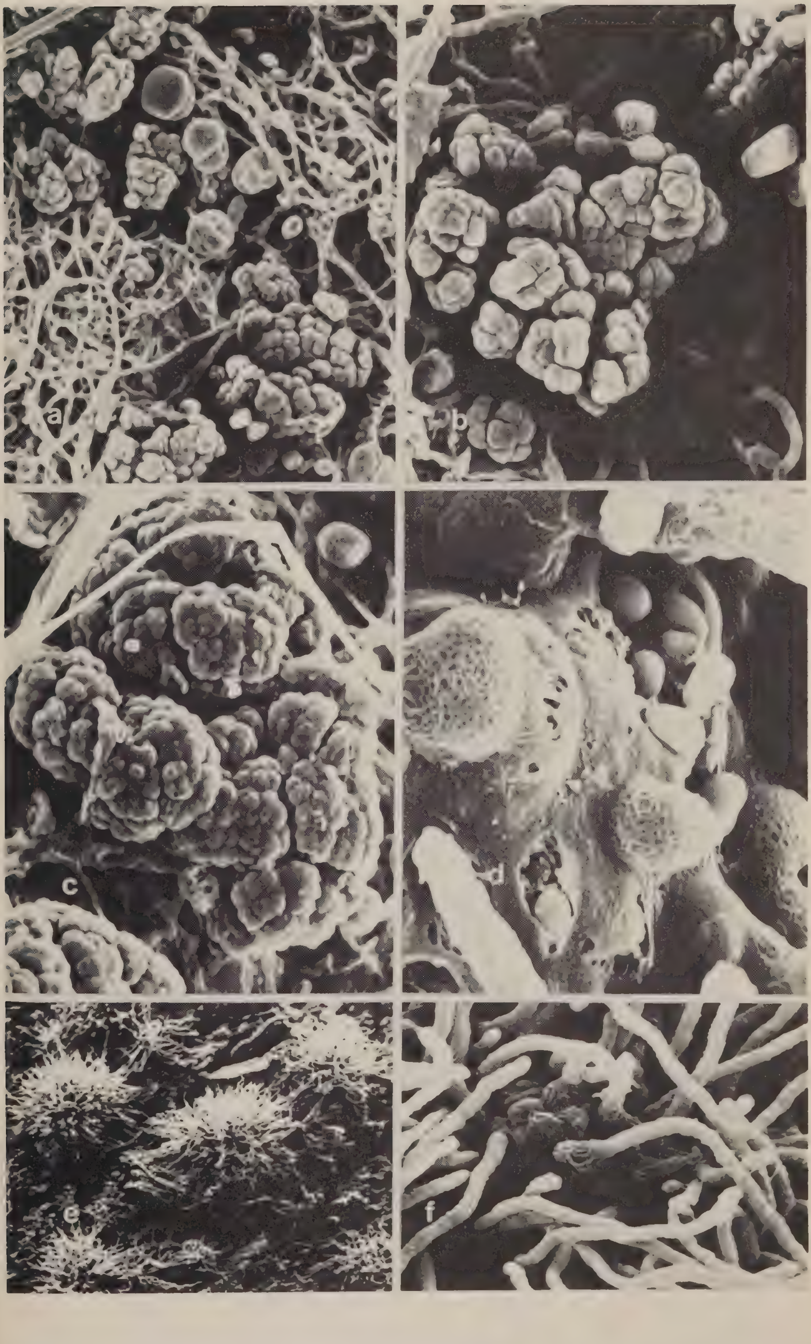
1. **Phaeotheca** Sigler, Tsuneda et Carmichael gen. nov.

Diagnosis

Fungi Imperfecti, Hyphomycetes.
Hyphae dematiae, infrequentes vel absunt. Coloniae restrictae, nigrae, multicellularium sclerotiformium cellarum gregatim, compositae. Cellae dividunt penitus forte; formandae unum, duo vel numerosa endoconidia. Endoconidia dematia, reniformia vel triangularia. Reproductio sexualis ignota.
Typus: *Phaeotheca fissurella* Sigler, Tsuneda et Carmichael.

Phaeotheca fissurella Sigler, Tsuneda et Carmichael sp. nov.

Fig. 1. *Phaeotheca fissurella.* a-c. Colonies composed of masses of sclerotic cells, among aeciospores of *Cronartium* and hyphae of another fungus. a, x200, b-c, x500. d. Endoconidia released by degeneration of mother cell wall, x1500. e-f. Hyphae produced on blocks of *Pinus contorta,* e, x30, f, x400.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Hyphae et endoconidia, et cetera in modo generis. Endoconidia fusca, 4-5.5 x 8-9.5 µm. Coloniae in agaro ad 18C restrictae, nigrae, mucosae et rugosae vel siccae specie et cerebriformes. Incrementum abest ad 25C. Typus: UAMH 4285, in cancro ex *Cronartio coleosporioide* in *Pino contorta*, Banff, Alberta, 1979.

Description

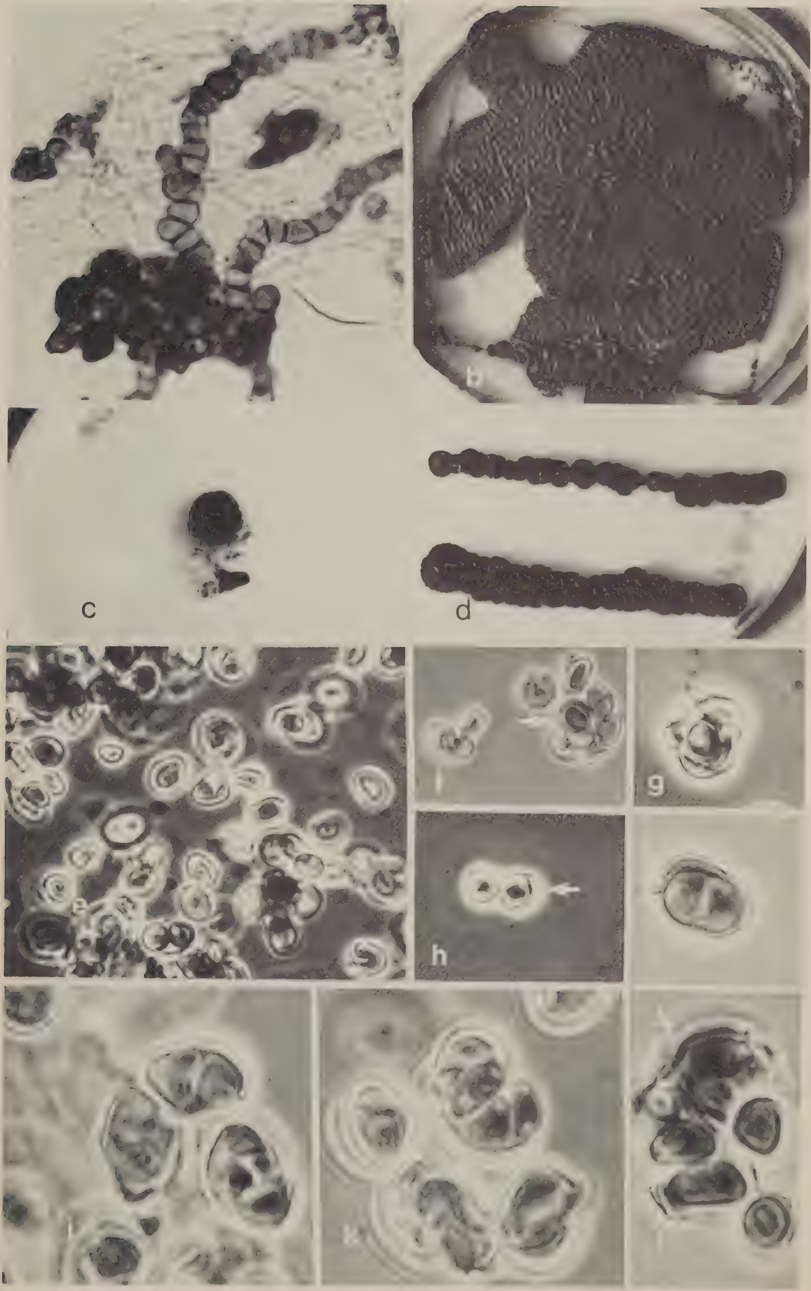
On the host, *Phaeotheca fissurella* produced black, punctiform colonies scattered on the bark of the canker and among the aeciospores. An individual colony, observed by scanning electron microscopy, appeared as a cauliflower-like mass of cells (Fig. 1a-c), which were at first smooth and undifferentiated (Fig. 1a), but later divided into clusters of 2 or more (Fig. 1b-c). Few hyphae were seen emerging from the sclerotic clusters. The hyphae adjacent to the clusters in Fig. 1a belong to another fungus, possibly *Hormonema dematioides* (UAMH 4298), which was also isolated from the canker. Light microscopic examination revealed masses of sclerotic cells and short hyphal strands (Fig. 2a).

When *P. fissurella* was grown on small blocks of *Pinus contorta* at 18C in a moist chamber, hyphae developed more abundantly than on the host (Fig. 1e-f). As the colony matured, the cell wall of the mother cells degenerated and single-celled conidia were released (Fig. 1d).

In culture, growth was optimal at 18C on potato dextrose agar (PDA, Difco), but there was good growth on phytone yeast extract agar (PYE, BBL), Pablum cereal agar and oatmeal agar (see Sigler and Carmichael, 1976). Colonies were notable for their black color and looked remarkably similar on all media. When grown on agar layered with a cellophane membrane (Sigler and Carmichael, 1976), colonies were flat or only slightly elevated, and very mucoid (Fig. 2c). If the plate were held and tilted, the colony spread across the membrane. The colony center became drier and more wrinkled after 2-3 weeks on PDA (Fig. 2b), but the margin remained mucoid. On PDA without cellophane, colonies spread very little and were wrinkled or cerebriform, drier and more elevated (Fig. 2d).

Phaeotheca fissurella is psychrophilic; growing well at 18C, slowly at 7C, but not at 25C. It is slightly cellulolytic but not keratinolytic.

Fig. 2. *Phaeotheca fissurella.* a. Sclerotic cells and hyphae on host, x600 BF. b-c. Colonies on cellophane on PDA after 2 (c) and 5 (b) weeks, x0.7. d. Colony on PDA with no cellophane after 3 weeks, x0.7. e. Endoconidia, slightly flattened on one side, X600. f-g. Single endoconidium developing within mother cell. f, x600, g, x950. h-l. Two or more endoconidia within mother cells, some showing remnants of mother cell wall (arrows). h, x600, i-l, x1600.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In agar culture, reproduction occurs by division of the mother cell into 1-several endoconidia (Fig. 2e-l). The developing endoconidium(ia) can be observed within the mother cell (Fig. 2f,j) and release is by rupture of the mother cell wall. Remnants of this wall can be seen around the conidia (Fig. 2g-i,k-l). Endoconidia are dark brown, frequently flattened on one side, and measure 4-5.5 x 8-9.5 µm. The number of endoconidia per cell is random, sometimes 1, frequently 3, but on PDA we found enlarged, sometimes hypha-like mother cells which divided to form numerous endoconidia (Fig. 3a-d).

Attempts to stain the nuclei of *P. fissurella* gave equivocal results. After the fungus was fixed and hydolyzed using Kendrick and Chang's (1971) procedure, it was bleached in 1.5% sodium hypochlorite to decolorize the melanized walls. At this concentration, the bleach decolorized the cell walls of the larger hypha-like mother cells, but not the mother cell wall containing a single endoconidium. Nuclei of *P. fissurella* were not visible when the fungus was stained with a buffered Wright's stain, "Camco Quik," yet nuclei of *Petriellidium boydii* stained by the same procedure. Nuclei were weakly stained by the Feulgen reaction using a cold Schiff reagent. There appeared to be one nucleus per developing endoconidium within the larger mother cells.

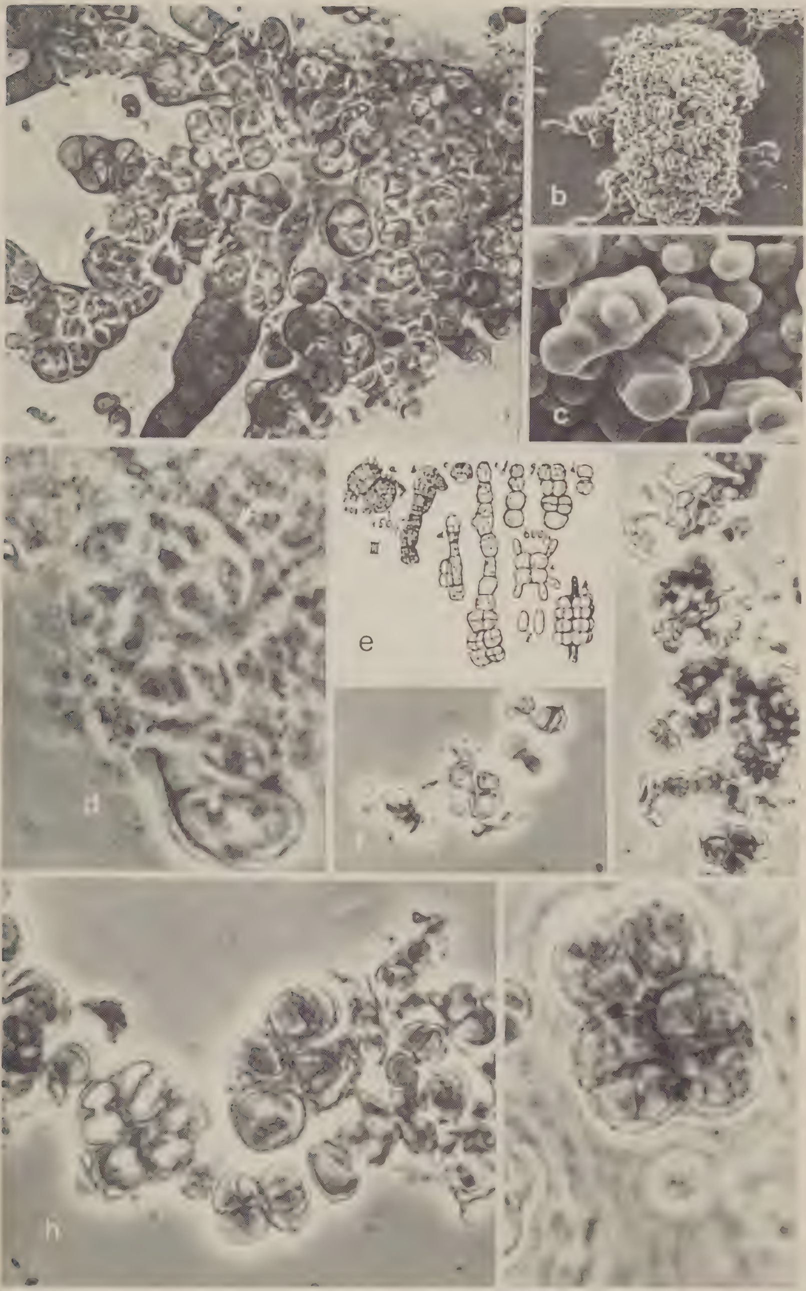
Hyphae formed most extensively when *Phaeotheca fissurella* was grown on the blocks of *Pinus contorta* or in slide culture, but still remained scant. No budding was seen.

Holotype: UAMH 4285, the type specimen, is on a canker of *Pinus contorta* caused by *Cronartium coleosporioides* coll. Saskatchewan crossing, Banff, Alberta, Sept. 1979, by J. Petty, as CFB 20955. A culture and dried colonies prepared from the type specimen are preserved in UAMH as 4245.

Discussion

Although *Phaeotheca* sometimes forms mucoid, yeast-like colonies, the genus is better placed with the Hyphomycetes rather than with the Blastomycetes since budding has not been observed. Endosporulation is an unusual method of conidium ontogeny in the Hyphomycetes. Sporangium-like endosporulation has previously been reported in *Prototheca* and *Coccidioides*.

Fig. 3. a-d. *Phaeotheca fissurella.* e-i. *Sarcinomyces crustaceus.* a-d. Colony on PDA displaying larger hypha-like mother cells containing numerous endoconidia. a, x600 BF, b, x75, c, x350, d, x1600. e. Lindner's line drawings of *Sarcinomyces crustaceus.* f-i. Bulbils on different substrates. f and h from Lindner's type specimen, f, x600, h, x1600. g. UAMH 4286 on *Endocronartium harknessii*, x600. i. 4286 on PDA, x1600.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Although originally described as a fungus, *Prototheca* is now generally considered to be an achlorophyllous alga which grows in culture medium in a yeast-like form (de Camargo and Fischman, 1979). *Prototheca* forms sporangial mother cells containing endospores which are released by rupture of the sporangial wall. Ultrastructural examination of *Prototheca* has demonstrated membrane-bound starch granules in the cytoplasm and storage granules occasionally bound by a single lamella which indicate a close relationship to the colorless algae (Nadakavukaren and McCracken, 1973; Kaplan, 1978). True chloroplasts have not been seen.

Fissuricella filamenta was originally described as a *Prototheca* (Arnold and Ahearn, 1972), but later transferred to *Sarcinosporon* by King and Jong (1975). However, the type species of *Sarcinosporon, S. inkin,* forms only hyphae and budding cells.

In their description of *Fissuricella*, Pore, d'Amato and Ajello (1977) noted that the cells became divided internally by cross-walls to form clusters of various sizes, but that there was no release of endospores even after mechanical disruption, and they found no empty mother cells. Since they observed some budding and their isolates were hyaline, they referred *Fissuricella* to the Blastomycetes.

Coccidioides immitis is a pathogen which reproduces in tissue by forming spherules which divide internally to form endoconidia. Sun and Huppert (1976), in their cytological investigation of spherule development, were unable to determine whether karyogamy preceded nuclear division in the developing spherule. Although endosporulating spherules of *C. immitis* can be induced *in vitro* in an appropriate medium (Sun and Huppert, 1976), *C. immitis* usually grows as a mold and produces alternate arthroconidia typical of *Malbranchea* (see Sigler and Carmichael, 1976).

Material examined: UAMH 4260, *Sarcinosporon inkin*, case of tinea cruris in Portuguese female caused by *Trichophyton tonsurans*, 1967, ATCC 18020; UAMH 4261, *Fissuricella filamenta*, TYPE, human skin, Cleveland, Ohio, by D.G. Ahearn, ATCC 22432.

2. **Sarcinomyces crustaceus** Lindner 1898, Mikroskopische Betriebskontrolle in den gahrungsgewerben mit einer Einfuhrung in die Hefenreinkultur, Infectionslehre und Hefenkunde. pp. 228-229, Ed. 2, Paul Pary, Berlin.
   =*Coniothecium crustaceum* (Lindner) Neger 1917

Historical Background

Lindner described two species in *Sarcinomyces*, dematiaceous *S. crustaceus* and hyaline *S. albus*. Although neither was designated as type species, Clements and Shear (1931, p. 392) listed *S. crustaceus*. Because no type material remains, the identity of *S. albus* is uncertain (de Hoog and Hermanides-Nijhof, 1977).

In 1917, Neger described several fungi occurring on fir trees which he called sooty fungi. One kind which occurred frequently, he identified as Lindner's *Sarcinomyces crustaceus*. His description and illustrations agree very well with Lindner's. He proposed a new combination for *S. crustaceus* in *Coniothecium* even though he noted the difficulty in identifying species of *Coniothecium* from published descriptions,

The form-genus *Coniothecium* is considered by Hughes (1958) to be a *nomen dubium* since no type material could be found for the type species, *C. atrum*. Most of the lichenicolous species of *Coniothecium* have been disposed in other genera (Hawksworth, 1975).

More recently, Hermanides-Nijhof (1977) examined the type specimen of *Sarcinomyces crustaceus* and placed *Exophiala werneckii* into synonymy with it, even though she was unable to determine the exact nature of conidiogenesis in *Sarcinomyces*. This disposition was not accepted by McGinnis (1979) or by Carmichael et al. (1980).

Lindner, in his original description, clearly described and illustrated (see Fig. 3e) the development of *Sarcinomyces*:

> "Aus der isolierten Spore (Fig. c) tritt nach dem Platzen der ausseren Haut ein hefezellahnliches Gebilde hervor, in dem jedoch bald Querwande erscheinen. Die Teilungen finden bei dem Wachstum so regelmassig statt, dass der neue Zellenkomplex oft genau Wurfelform annimmt (Fig. k). Die Zellen sind glashell und gleicht das ganze Gebilde durchaus einer Sarcina maxima. Waren ganze Zellreihen ausgekeimt, dann entstehen Gebilde wie in a und b."

However, in our examination of a slide prepared from the type of *S. crustaceus*, we found only thick-walled dematiaceous cells which were usually divided transversely and longitudinally to form units of 4 or more (Fig. 3f,h). We found neither endoconidia nor any evidence of budding. Also we found no annellated butts as described by Hermanides-Nijhof (1977).

Although the type specimen of *S. crustaceus*, which is an air dried culture grown on wood, shows only sclerotic cells, one of our isolates, from a gall of *Endocronartium harknessii*, does show both the sclerotic and blastic states illustrated by Lindner (see Fig. 3e) and Neger. This isolate is described below.

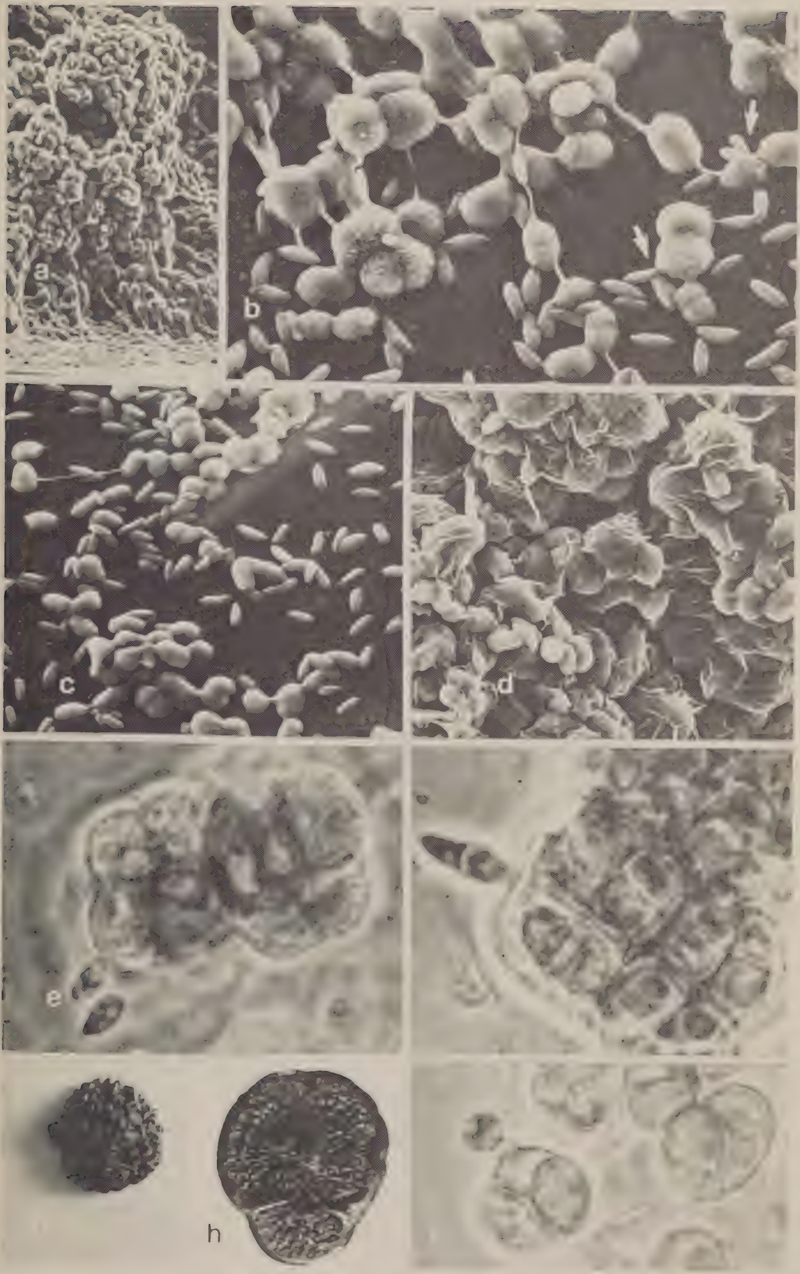
Description

On the host, *Sarcinomyces crustaceus* appeared as small, black, discrete colonies scattered among the aeciospores and on the outside bark of the gall. Macroscopically, the colonies greatly resembled those of *Phaeotheca fissurella*. Material from these colonies, when examined microscopically, was composed of multicellular aggregations (Fig. 3g), occasional 2-celled fragments and scant hyphae.

In culture, *S. crustaceus* formed clusters of brown sclerotic cells or bulbils which often became warty in age (Fig. 3i,4b). They measured from 25-70 um initially, and in older cultures disassociated reluctantly. From these multicellular packets, blastic conidia were expressed (tretic conidiogenesis?). The conidia emerged singly from different loci (Fig. 4b). We found no evidence of successive conidiogenesis from the same locus. No detachment scar or butt could be seen on the sclerotic cells. When first produced, the conidia are small, hyaline, single-celled, filiform and measure 1.5-2 x 4.5-7 µm (mostly 2 x 5 µm)(Fig. 4c,e). After detachment, the conidia enlarged (to 3-5 x 7-8 µm), became pale brown, and divided transversely, then longitudinally and continued to divide to form the multicellular bulbils (Fig. 4c). Occasionally, enlargement and septation occurred while the conidium remained attached (Fig. 4f). Only rarely, we observed the filiform conidia emerging from non-septate dematiaceous cells. Occasionally, cracks or splits occurred in the cell wall of the warty bulbils, but no endoconidia were released. A similar peeling of the outer layer has been observed in the multicellular sclerotic bodies of *Wangiella dermatitidis* (Szaniszlo et al., 1976) and by us in isolates of *Phaeococcomyces nigricans* (unpublished data, UAMH 4084,4297).

The production of blastic conidia from the sclerotic cells was influenced by the conditions of growth. They were abundant in mucoid regions of colonies on PDA (Fig. 4a) and cereal agar, yet occurred less frequently in dry colonies. We found none in material taken from the gall of *Endocronartium harknessii* (Fig. 3g). It appears that growth of *Sarcinomyces* occurs either in a dry or a mucoid state; in the dry state bulbil formation predominates, whereas in the slimy state blastic conidia are abundant.

Fig. 4. a-h. *Sarcinomyces crustaceus.* i. *Wangiella dermatitidis.* a. Colony on PDA. Central region composed of clusters of sclerotic cells or bulbils, outer mucoid margin containing blastic conidia, x200. b. Blastic conidia borne singly from different loci on smooth or warty bulbils, x800. c. Stages in development from blastic conidia to bulbils, x550. d. Slimy coating on bulbils, x700. e-f. Single and two-celled conidia emerging from bulbils, x1600. g-h. Colonies on PDA (g) and cereal (h), x0.7. i. Budding and sclerotic cells of UAMH 4278, x1600.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On the host, we see the former, and this may explain the lack of blastic conidia in the type specimen of *Sarcinomyces* (which was grown on wood).

Small capsules were observed when material from mucoid colonies was viewed by negative stain. This slimy covering can also be seen by scanning electron microscopy (Fig. 4d).

Colonies resembled those of *Phaeotheca* and also grew best at 18C. On cereal agar with cellophane, colonies (Fig. 4h) were black, initially flat with radial folds, mucoid and glistening, later drier and elevated in the centre, and mucoid at the margin. After 6 weeks, they measured 33 mm. On PDA and PYE, colonies adhered poorly to the cellophane and were dry and crumbly. Colonies (Fig. 4g) on PDA without cellophane after 42 days were black, glistening with slime, cerebriform and elevated, and measured 22 mm. Streaked colonies on PDA had a metallic sheen. Growth on PYE was poor. There was good growth at 7C, but very scant growth at 25C.

Sarcinomyces crustaceus grew abundantly at the surface of Brewer's thioglycollate broth (Difco), and the growth consisted predominantly of sclerotic cells with few blastic conidia. In contrast, *Phaeotheca fissurella* and *Phaeosclera dematioides* showed only scant growth.

The description above is based on UAMH 4286. Late in the study, we found another isolate, UAMH 1553, which had been received as *Sirodesmium* sp. and later filed as *Coniosporium* sp. This strain, when regrown on cereal agar and PDA also formed the distinctive blastic conidia from sclerotic cells. However, this isolate differed from UAMH 4286 in growing more rapidly at 25 C, and in forming extremely wet colonies which, when incubated upside down in petri dishes, dripped on to the lid of the petri dish. Mounts from the material on the lid revealed abundant blastic conidia. In young cultures, hyphae emerged from clusters of the bulbil-like masses, but these hyphae soon became converted to bulbils. This strain may represent a different species of *Sarcinomyces*, but until more isolates have been found, it is difficult to determine the range of variation for the species.

Discussion

Sarcinomyces is treated here as a form-genus of the Hyphomycetes, along with the other so-called black yeasts (de Hoog and Hermanides-Nijhof, 1977). However, the dividing line between the Blastomycetes and the Hyphomycetes is not clearly defined (see Carmichael et al., 1980; p. 6).

Sclerotic cells have previously been reported in a strain identified as *Wangiella dermatitidis* (UAMH 4278 =Duke 3378, see Jotisankasa, Nielsen and Conant, 1970).

When Jotisankasa et al. (1970) examined the dry, granular colonies of this strain, they found only large cells divided transversely and longitudinally. They did not see budding. When we grew this strain on PDA and cereal agar, we found both budding and sclerotic cells (Fig. 4i). A yeast cell developed multiple broad-based buds, or the budding was bipolar and resulted in short chains of budding cells. In old cultures, sclerotic cells predominated. No true hyphae were seen. This isolate differs from other strains of *W. dermatitidis* which require acidic conditions to form the sclerotic bodies (Szaniszlo et al., 1976). It differs from *Sarcinomyces* in forming multiple broad-based buds and chains of budding cells. *Phaeococcomyces* de Hoog also forms broad based buds and chains of budding cells, but is not known to produce sclerotic cells. Therefore, the status of this isolate remains undecided.

Material examined of *Sarcinomyces crustaceus*: slide ex TYPE, dried culture on wood with dextrose nutrient fluid, isolated from air by Lindner, Mus. Bot. Berlin, slide prepared by M.R. McGinnis, NCMH 769; UAMH 1553, from air, received from C.L. Kramer, Univ. Kansas, 1963; UAMH 4286, on gall of *Endocronartium harknessii* on *Pinus contorta*, Jasper, Alberta, coll. Oct. 1978, by A. Tsuneda, isol. L. Sigler, May 1980.
Isolates of *Phaeococcomyces*: *P. catenatus*, UAMH 2901, air contaminant, Edmonton, by A. Padhye, 1968; *P. nigricans*, UAMH 4084, type, paint of storage tank, U.S.A.; UAMH 4123, contaminant, Edmonton, by L. Sigler, 1978; UAMH 4297, gall of *Endocronartium harknessii* on *Pinus contorta*, Jasper, Alberta, by L. Sigler, 1980.

3. **Phaeosclera** Sigler, Tsuneda et Carmichael gen. nov.

Diagnosis

Fungi Imperfecti, Hyphomycetes.
Hyphae dematiae, septatae, mutabiles. Bulbillae evolvunt ex hyphis post multiplices septationes. Vetustae bulbillae separant difficiliter. Coloniae atrae, bulbillarum compositae.
Typus: *Phaeosclera dematioides* Sigler, Tsuneda et Carmichael

Phaeosclera dematioides Sigler, Tsuneda et Carmichael sp. nov.

Hyphae et bulbillae in modo generis. Bulbillae fuscae vel furcae, 10-50 µm vel grandiores, in mucosa matrice. Coloniae atrae, restrictae, altae, cerebriformes, nitidae propter mucum. Typus: UAMH 4265, in medulla viva in *Pino contorta*, Strachan, Alberta 1957.

Description

On blocks of *Pinus contorta* after 3 weeks, colonies consist of bulbil-like masses with a slimy coating (Fig. 5a,e). Few hyphae are produced (Fig. 5b).

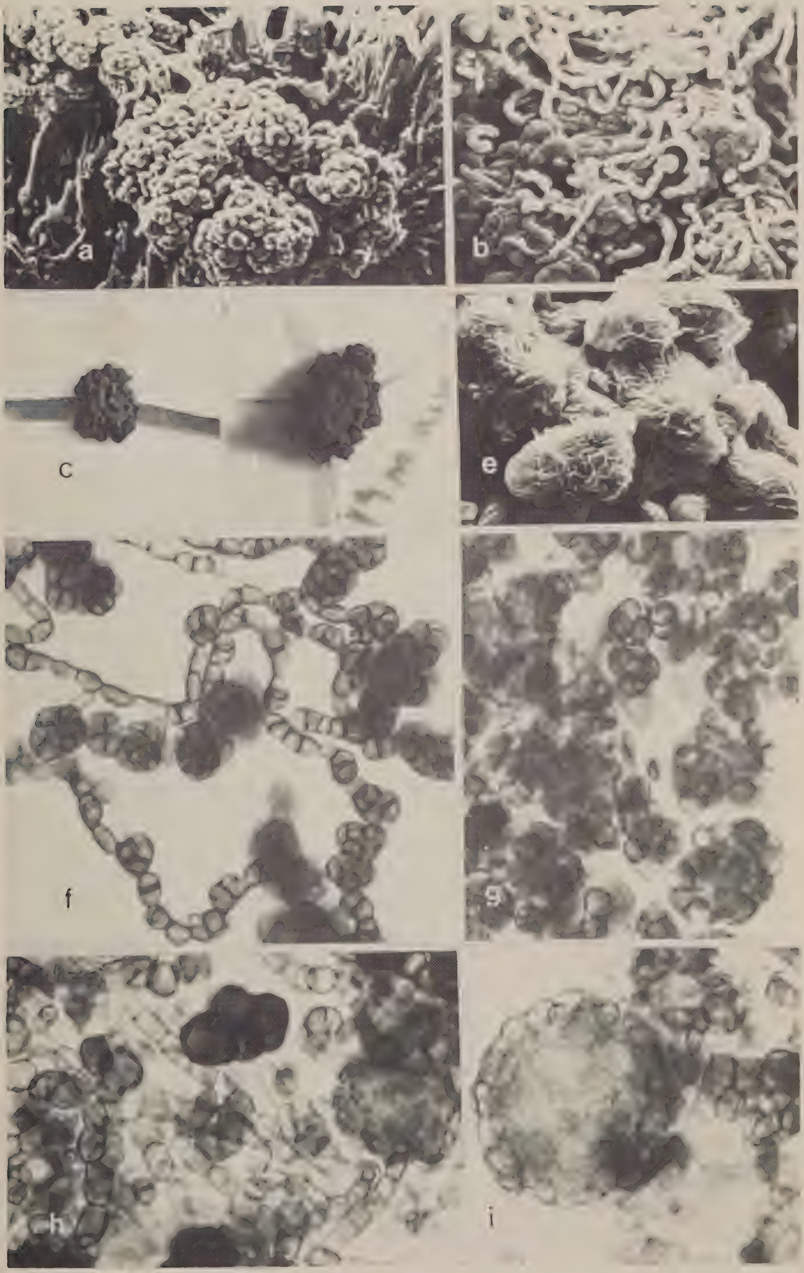
Colonies on all media appear similar. On agar without cellophane at 25C (Fig. 5c-d), they are dull black, slow growing (after 35 days approximately 17-22 mm in diameter), matted, cerebriform, dry (on PYE and PDA) or enveloped in slime and glistening (on cereal). The colonies are elevated and after 4-5 weeks may touch the lid of the petri dish. The margin digs into the agar and after several weeks, deep cracks appear in the agar below the colony. Because the colonies are tough and matted, or enveloped in slime (on cereal), they are difficult to tease apart for microscopic preparations and when dried (for method, see Sigler and Carmichael, 1976), become extremely hard. Colonies at 18C are similar but grow slightly slower. There is scant growth at 7C. Growth on cellophane is more restricted and colonies adhere poorly.

The hyphae are dematiaceous and septate, but rapidly convert to thick-walled bulbil-like masses. The conversion occurs randomly as short segments of a hypha enlarge and divide both transversely and longitudinally (Fig. 5f-g). Eventually the entire hypha is converted to a bulbil-like mass of sclerotic cells. Older cultures are composed of dark brown, smooth bulbil-like masses of variable size (from 10 µm to as large as 50 µm or more) which separate from each other reluctantly even when teased apart (Fig. 5g). They are sometimes covered in a slimy coating (Fig. 5e). Occasionally, a splitting or shedding of the wall of a bulbil could be seen. No other conidia were produced on any medium or at different temperatures.

Muriform, dematiaceous fungi isolated from wood or trees have often been called *Fumago* sp. Indeed, the two strains described above are probably the same species as an isolate identified by Wang (1965, p. 52) as *Fumago* sp. Unfortunately, her culture is no longer available (personal communication).

Holotype: UAMH 4265, pith of *Pinus contorta*, Strachan, Alberta, by R.J. Bourchier, May 1957, from A. Tsuneda as C-428.

Fig. 5. a-g. *Phaeosclera dematioides*. (a-b,e, UAMH 4251; c-d,f-g, UAMH 4265). h-i. *Soredospora graminis*. a-b. Colonies on *Pinus contorta* showing bulbil-like masses of sclerotic cells and hyphae, a, x250, b, 340. c-d. Colonies on cereal (c) and PYE (d) after 5 and 6 weeks, x0.7. e. Slimy coating on bulbil-like masses, x600. f-g. Development of bulbils by conversion of hyphal cells, x600 BF. h-i. Hyphae, dictyoconidia (arrow) and globose, multicellular structures, x600 BF.


a
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Other strain examined: UAMH 4251, pith of *Pinus contorta*, Kananaskis Forest, Alberta, by R.J. Bourchier, May 1957, from A. Tsuneda as C-430.

GENERAL DISCUSSION

Both *Phaeotheca fissurella* and *Sarcinomyces crustaceus* grow on the host as discrete black colonies composed of masses of sclerotic cells and occasional hyphae (Figs. 2a,3g). They are identified by their unique development in agar culture. No original host material was available for the two isolates of *Phaeosclera dematioides*, but when grown on blocks of wood, they also formed bulbil-like masses (Fig. 5a) with scant hyphae.

Dematiaceous, sclerotic, somewhat nondescript fungi have frequently been observed on or isolated from wood and trees. In one of the early reports on culture of sooty molds, Neger (1917) found that *Sarcinomyces crustaceus* occurred frequently on fir trees. By growing *S. crustaceus* in culture, Neger was able to observe the distinctive blastic conidia produced from the sclerotic cells. In transferring *S. crustaceus* to *Coniothecium*, he noted that published descriptions of *Coniothecium* contained no mention of these special "sprout" conidia. He concluded that these fungi could only be identified with certainty from pure culture.

Late in the study, we examined a slide from the presumed type of *Coniothecium epidermidis* on *Betula* (ex Herb. Corda Prague, 155448, DAOM 40978) which also showed dematiaceous sclerotic cells. There were also a few, broad thick-walled hyphae which appeared to be a different fungus. We concur with Neger that cultures are necessary to establish even the generic identity of masses of sclerotic cells on wood. Therefore, *C. epidermidis* Corda (1837, Icones Fungorum I:2 and Tab. I, fig. 24) may be considered a *nomen dubium*.

Hughes (1976) defined sooty molds as a group of saprophytic fungi which form dark colored colonies on a variety of living plants. Sooty molds can grow as hyphae, as hyphal plates or as clusters of isodiametric cells. One common type of sooty mold is a thin, confluent black layer predominately on the upper surface of leaves or bark of broad-leafed trees. Traditionally, this type of growth has been called *Fumago vagans*. Microscopically, it consists of dematiaceous, muriform cells and *Cladosporium* conidia (Friend, 1965a,b). One of the problems in identifying sooty molds is that several species frequently grow together and are not readily distinguishable from each other on the host (Hughes, 1966). Indeed, when Friend (1965a,b) cultured scrapings of the black growth found on lime trees in England, he found that the principal components were *Aureobasidum pullulans, Cladosporium herbarum* and occasionally *Alternaria*. Since *F. vagans* was composed mostly of two elements, Friend (1965b) rejected it as a *nomen confusum*. When we examined black material on the upper side of branches from local *Populus tremuloides*, we also observed brown, thick-walled masses of cells and a few short segments of hyphae. In culture, we grew *A. pullulans* and *C. herbarum* (UAMH 4347 and 4348).

The mixture of *A. pullulans* and *C. herbarum* known as *F. vagans* is one of the few sooty molds that grows readily in culture. The other sooty molds described by Hughes (1976) are known only from the host. However, they often form distinctive sporulating structures, in contrast to the multicellular aggregations of the *Fumago vagans* type.

Neger called *Sarcinomyces crustaceus* a sooty mold. Indeed, our isolates of *Sarcinomyces* and *Phaeotheca* appear to fit Hughes' (1976) definition of sooty molds. However, both formed small, discrete colonies localized on or near rust cankers and grew readily in culture. *Phaeosclera* is known to us only from culture. In any event, cultures are necessary to distinguish these genera of dematiaceous, sclerotic fungi.

Another dictyosporic, dematiaceous genus with questionable status is *Soredospora* (Carmichael et al., 1980). Hughes (1958) transferred the type species, *Soredospora graminis*, to *Fumago*. We have examined slides prepared from the type specimen (grass leaves, ex Herb. Corda Prague 155636, DAOM 50059). They consist of dark brown, *Peyronelia*-like dictyoconidia (Fig. 5h) borne on undifferentiated hyphae, along with globose, multicellular structures (Fig. 5i) (immature ascomata? or conidiomata?) and a few conidia of the *Cladosporium* type. *Soredospora* appears to be a *nomen dubium* or *nomen confusum*.

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BASIDIUM REPETITION IN CONFERTICIUM (CORTICIACEAE, BASIDIOMYCETES)

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The genus Conferticium, a segregate from Gloeocystidiellum, was founded among other things on the occurrence of basidial repetition (Hallenberg 1980). In the description of the genus basidial repetition was said to be occasional but later investigations have shown that it seems to be the sole mode of development in older hymenia.

MATERIALS AND METHODS. The following species were examined:

Conferticium insidiosum (Bourd. & Galz.) Hallenb./Iran, Gorgan, Golestan forest/On a fallen log/1978-05-01/ N. Hallenberg 2278.

C. karstenii (Bourd. & Galz.) Hallenb./Sweden, Uppland, Uppsala/On a decayed trunk of Populus tremula/1948-05-16/ J.A. Nannfeldt 9769.

C. ochraceum (Fr.) Hallenb./Sweden, Värmland, Långserud/On a fallen trunk of Picea abies/1975-06-10/ T. Hallingbäck 8864.

Gloeocystidiellum lactescens (Berk.) Boid./Sweden, Södermanland, Bälinge/On a stump of Fraxinus excelsior/1975-11-09/ I. Nordin 6275

Horizontal sections, 10—30 um from the hymenial surface, were studied in transmission electron microscope. In C. insidiosum also vertical sections were studied. Although not belonging to Conferticium, Gloeocystidiellum lactescens is included in this investigation for comparative studies.

Pieces of fructifications were fixed in 4% glutaraldehyde at 4°C. After washing in phosphate buffer the pieces were postfixed in 2% osmiumtetroxide at room temperature. The samples were dehydrated in an ethanol series and embedded in a low-viscosity epoxy resin according to Spurr (1969). The sections were cut with glass knives on a LKB ultratome III ultramicrotome, poststained with 4% uranyl acetate and lead citrate (Reynolds 1963), and finally examined with a Philips EM 301 electron microscope.

RESULTS AND CONCLUSIONS. Horizontal sections were taken from the basidial and subbasidial level in the fructifications. Sections from *Conferticium*-species show that the cell walls are composed of several layers (fig. 1 A, 1 B, 2 B, arrows). In some parts of the sections, two cells (i.e. sectioned basidia or hyphae) seem to be joined by a common outer wall (fig. 2 B, dubble arrow; in 3 B reproduced as a drawing). The vertical section of *C. insidiosum* (fig. 1 C, reproduced in 3 C) shows branching of hyphae within common outer walls. The branching takes place proximal to the septum, which besides has a distinct dolipore (fig. 1 C, arrow).

When vertical sections from fructifications of *Conferticium*-species are observed in a light microscope, basidial repetition is frequently observed (fig. 3 A). However, still more often it is seen that walls of vertical hyphae are fragmented ("scaly") on their outside when mounted in KOH solution. These "scales" must be interpreted as outer hyphal walls, destroyed by the crushing when making the preparate.

Fructifications of *Conferticium*-species are developed from a very thin subiculum. Thereon a dense hymenium is formed, probably without any basidial repetion involved. As the hymenium is thickening, repetition from the old basidia or from single vertical hyphae seems to be the normal development. When branching occurs in this very dense tissue, it seems to take place within an already formed cell (fig. 3 B, C).

On the contrary, in *Gloeocystidiellum lactescens* the cell walls have obviously only one layer (fig. 2 A, arrow). Besides, no internal, basidial repetition is observed in the light microscope.

Common characters for *G. lactescens* and *Conferticium* are the vertically directed hyphae in the fructification, the lack of clamps and the amyloid spores. For further details concerning the anatomy of the species discussed here, see Eriksson & Ryvarden (1975) and Hallenberg (1980).

Hitherto has obligate basidial repetition only been observed in *Repetobasidium* John Erikss. In that genus, repetition is caused by a protuberance from an old basidial septum growing into the old basidium. The location of earlier formed septa on basidiophorous hyphae is easily seen, due to the presence of clamps.

Even if basidial repetition in *Conferticium* is unquestionable, it is not necessarily performed in the same way as in *Repetobasidium*. The closely packed texture and the absence of clamps make it difficult to see the finer details in this process.

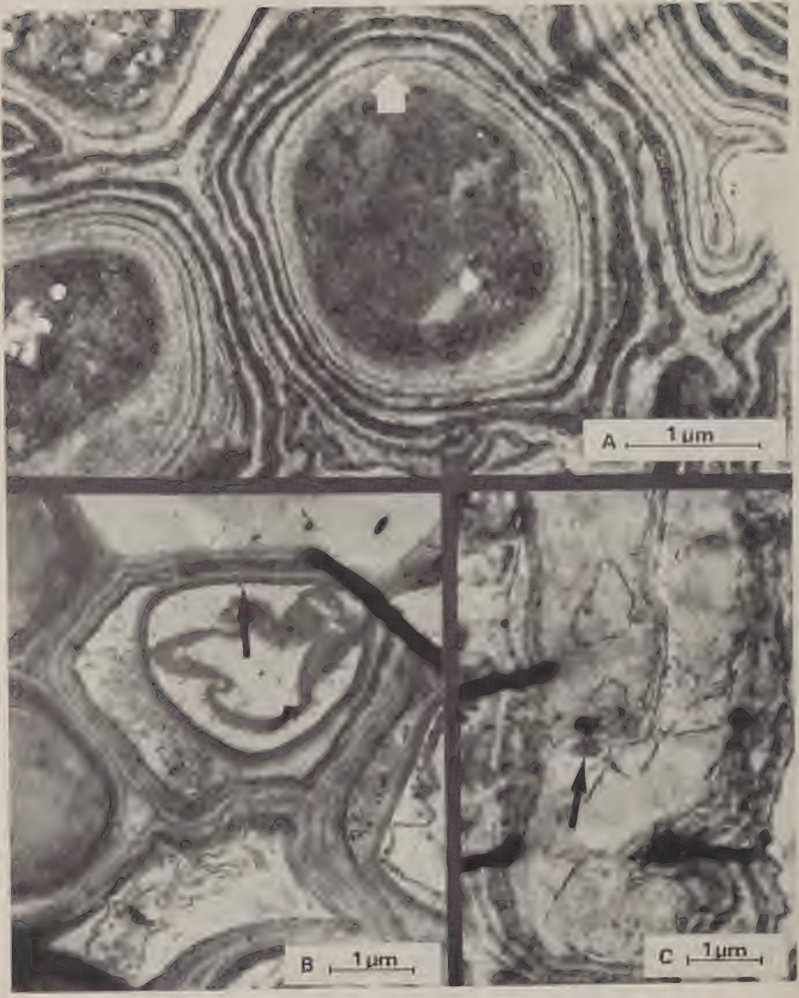

Fig. 1. A) Horizontal section from Conferticium insidiosum. B) Horizontal section from C. karstenii. C) Vertical section from C. insidiosum.

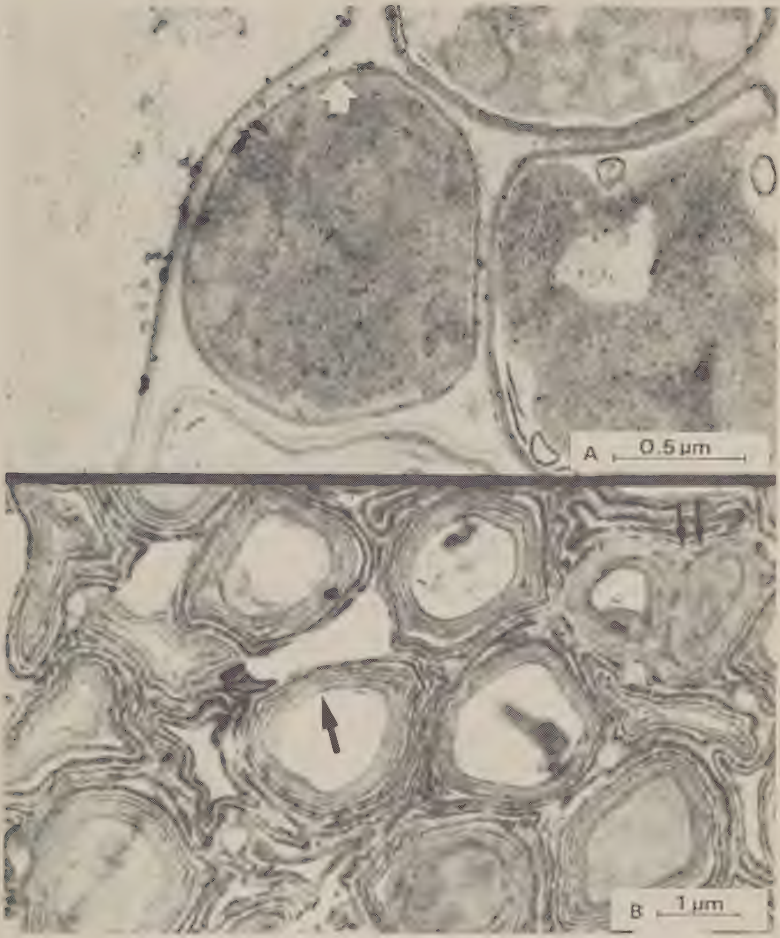

Fig. 2. Horizontal sections from A) *Gloeocystidiellum lactescens*, B) *Conferticium ochraceum*.

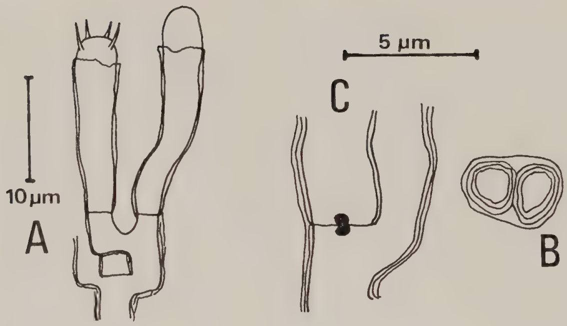

Fig. 3. A) Hymenial detail in *Conferticium insidiosum*.
B) *C. ochraceum*, drawing reproduction of a part of fig. 2 B.
C) *C. insidiosum*, drawing reproduction of fig. 1 C.

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SYNOPSIS OF WOOD-INHABITING APHYLLOPHORALES (BASIDIOMYCETES) AND HETEROBASIDIOMYCETES FROM N. IRAN

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ABSTRACT. The hitherto known wood-fungus flora in the Caspian forests (N. Iran) is presented herewith. Relations to the deciduous forests of the nemoral zone in Europe are discussed, as well as general patterns for the distribution of wood-fungi within this zone. Altogether 275 species are recorded here from Iran, among them 80 for the first time.

THE ENVIRONMENT. On the northern slopes of the Elburz mountains (N. Iran) there is a rich deciduous forest. Humid winds from the Caspian Sea is the basis for this vegetation. Though isolated by dry mountains in W. and S. and steppes in E., the Caspian forests clearly belong to the nemoral zone in Europe. The climatic conditions are favourable enough to allow cultivation of, among other things, rice, cotton and tea in the lowlands. Even if the summers are hot (25-27°C, the average for July) there is a distinct winter season with a January mean temperature a few degrees above freezing point. Higher up in the mountains there is a sharp drop in the winter temperatures, with January minima down to -30°C and with frosty days for up to 5 months. The precipitation is high (800 - 2000 mm/annum) and rather evenly distributed over the year. Most of the plain close to the Caspian Sea is cultivated. Natural forest vegetation occurs in river valleys and on the mountain slopes. From these forests come the great majority of collections of wood-fungi in Iran. The area is divided into three provinces, viz. (from W. to E.) Gilan, Mazanderan and Gorgan.
For further details about vegetation and climate, see Zohary (1973).

INVESTIGATIONS ON THE WOOD-FUNGUS FLORA. Before 1972 there were only scattered records (see below). Saber (1972, 1974), Soleimani (1975) and Ershad (1977) were the first to make comprehensive works on the wood-fungus flora in Iran, while in 1976 and 1978 I collected wood-fungi in the area, which resulted in 208 species new to Iran. In this synopsis 275 species are recorded, among them 80 for the first time from Iran.

NOTES ON FUNGAL GEOGRAPHY. The distribution of wood-fungi in N. Europe has earlier been discussed by Eriksson (1958), Eriksson & Strid (1969) and Strid (1975). From the numerous collections made in this area it is obvious that several factors are involved in the distribution of wood-fungi.

The *habitat* is an important factor which also reflects the local climate essential for the species concerned. Species which are mostly found on still-attached twigs and branches, seem to be adapted to the dry condition where these substrates are placed. On the other hand, species growing on fallen trunks in herbaceous river valleys seem to be favoured by the more humid conditions existing there.

The *substrate* on which a species is growing is another factor. The distribution of wood-fungi preferring a certain substrate is often limited by the general distribution of the latter. The same may also be valid for particular forest types which usually inhabit a characteristic wood-fungus flora. Even if the development of particular forest types (e.g. nemoral, deciduous forests; boreal, coniferous forests) may be influenced by local conditions, their general distribution seems to be determined mainly by the macro-climate, as does the distribution of wood-fungi. However, the geographical limits of the latter are not necessarily the same as for the forest types where these fungi usually grow. Besides, a great deal of wood-fungi is found in many different forest types and distributed over almost the entire N. hemisphere.

In the present study comparisons have been made between the wood-fungus flora of the deciduous forests in N. Iran and the nemoral zone in Europe. This zone, as defined by Walther (1973), is characterized by a rather rainy and warm vegetational period of 4 - 6 months, while winters are rather short (usually 3 - 4 months) and mild or at least not extremely cold. The forest vegetation is mainly composed of deciduous trees and the zone in Europe covers the C. and W. parts down to the Mediterranean area, and is in the N. limited to S., W. Sweden and the most S. part of Norway.

The Caspian forests may be regarded as the S.E. limit of the nemoral zone and especial attention has been paid to making a comparison with deciduous forests at it´s N. limits in Europe.

This comparison shows that 78 % of the species recorded here have also been collected in N. Europe. Furthermore, as an example, 68 % of the species found on a little island in C. Sweden (Högholmsskär in Lake Mälaren) with virgin nemoral vegetation, are even common to N. Iran.

GENERAL PATTERNS OF DISTRIBUTION IN EUROPE FOR SPECIES FOUND IN THE CASPIAN FOREST. The following species are in Europe confined to the Central-Eastern and South-Eastern parts:

Cystostereum heteromorphum
Donkia pulcherrima
Hyphoderma litschaueri
Hypochnicium caucasicum
Vuilleminia cystidiata
Xylobulus subpileatus
Schizopora carneo-lutea
Inonotus nidus-pici
Bourdotia galzinii
Dacrymyces minor

Still more species added to this group which besides, even are found in E., S.E. parts of Northern Europe (though mostly very rarely):

Cystostereum subabruptum
Hyphodontia spathulata
Peniophora lilacea
Phanerochaete raduloides
Phlebia lindtneri
Scytinostroma galactinum
Vararia ochroleuca
Datronia stereoides
Trichaptum biforme
Phellinus punctatus

Central - Southern species in Europe:

Auriculariopsis ampla
Conferticium insidiosum
Fibrodontia gossypina
Hyphoderma transiens
Hyphodontia juniperi
Peniophora proxima
Phanerochaete martelliana
Phlebiopsis roumeguerei
Stereum insignitum
Vuilleminia megalospora
Lenzites warnieri
Oxyporus latemarginatus
Polyporus arcularius
Rigidoporus ulmarius
Trametes cervina
T. ljubarskyi
Tyromyces gilvescens
Phellinus torulosus

Most of the species common to N. Iran and N. Europe are in the latter area confined to nemoral forests in the South and along the coasts. However, except for the E., S.E. species mentioned above there are still some having a more restricted distribution in N. Europe.

Species growing in areas with mild winters in Europe (along the S.W. coast of Norway, the W. coast in Sweden, and the entire Denmark) are:

Hyphodermella corrugata
Lopharia spadicea
Mycoaciella bispora
Peniophora lycii
Pulcherricium coeruleum
Stereum rameale
Trechispora alnicola
Aurantioporus alborubescens
Ganoderma australe
G. resinaceum

Some species growing on deciduous wood in N. Iran, but found on coniferous wood in N. Europe are:

Athelia decipiens
Botryobasidium obtusisporum
Dacryobolus sudans
Fibulomyces septentrionalis
Phlebia centrifuga
Antrodia lindbladii
Tyromyces hibernicus
T. placenta

Most of these species, together with Ceraceomyces borealis and Gloeoporus pannocinctus, belong to the boreal wood-fungus flora.

Further, some species also more or less common in all parts of N. Europe are:

Botryobasidium botryosum
B. subcoronatum
Cristinia helvetica
Hyphoderma praetermissum
Hyphodotia subalutacea
Laeticorticium roseum
Merulius tremellosus
Phanerochaete sordida
Sistotrema brinkmannii
Trechispora farinacea
T. vaga
Coniophora puteana
Bjerkandera adusta
Ceriporia viridans
Cerrena unicolor
Fomes fomentarius
Fomitopsis pinicola
Gloeoporus dichrous
Piptoporus betulinus
Polyporus varius
Pycnoporus cinnabarinus
Trametes pubescens

OTHER DISTRIBUTIONAL PATTERNS.

A few species that have earlier only been collected in N. America are:

Botrybasidium curtisii (perfect state)
Gloeodontia columbiensis
Ceriporia alachuana
Nigroporus niger
Phellinus johnsonianus

A few having a tropical - subtropical distribution are:

Coriolopsis floccosa
Schizopora trichiliae
Coltricia spathulata

The following species are so rare that it is impossible to say anything about their distribution:

Hyphoderma echinocystis
Phanerochaete septocystidia
Tubulicrinis thermometrus
Heteroporus fractipes
Sistotrema camshadalicum

Finally, a number of species which hitherto have only been collected in N. Iran:

Botrybasidium grandinioides
Cystostereum stratosum
Fibrodontia subceracea
Galzinia longibasidia
Oliveonia subfibrillosa
Peniophora pseudonuda
Phanerochaete aculeata
P. macrocystidiata
Phlebia caspica
Sistotrema resinicystidium
S. suballantosporum
Trechispora dimitica
T. fibrillosa
T. granulifera
Tubulicrinis incrassatus
Ganoderma manoutchehrii

Two species which are very common in deciduous forests in N. Europe, viz. Stereum rugosum (Pers. ex Fr.)Fr. and Phlebia radiata Fr., have apparently not been collected in the Caspian forests. One earlier record of Stereum rugosum (Watling & Sweeney, 1975), has been proved to be Xylobolus subpileatus.

Some species have been excluded from the above lists, for though reported from Iran they have never been collected in the Caspian forests:

Lopharia heterospora
Pyrofomes demidoffii
Inonotus hispidus
I. pseudohispidus

Further, species only collected on introduced coniferous trees have also been excluded:

Conferticium ochraceum
Gloeophyllum sepiarium
Heterobasidion annosum
Heteroporus biennis

GENERAL CONCLUSIONS ABOUT THE DISTRIBUTION OF WOOD-FUNGI IN NEMORAL FORESTS.

Even today too little is known about the wood-fungus flora in different parts of the nemoral zone. However, from available records it is possible to observe some differences in the distributional patterns. Even if most of the fungi found in N. Iran are distributed all over the nemoral zone, there must be some reasonable explanation for the more restricted distribution which is apparent for some of the species recorded here.

HUMIDITY: In most places within the nemoral zone, the precipitation is high enough and sufficiently spread over the year to allow the development of a deciduous forest. Even if these may have different features, most collections of wood-fungi are made in mainly virgin forests with lots of dead wood of different dimensions and in varying positions. These substrates offer a series of different conditions of humidity for the fungi. As this is the situation existing almost all over the nemoral zone, humidity cannot be considered as a differentiating factor in the geographical distribution of wood-fungi.

TEMPERATURE: The isotherms in Europe has different directions in summer and winter. During the summer they run from W. to E., while during the winter in a N.W. - S.E. direction. Then it is cold in the N.E. and mild in the S.W. It seems that the distributional patterns for the nemoral wood-fungi are mainly determined by the temperature, when considered over the whole year. The E. - S.E. species are apparently adapted to endure the cold winters, at the same time as they are favoured by long and warm summers. They seem to be driven out from the W. parts, where winters are milder and summers still warm by the competition of other fungi. On the other hand, some species require mild winters or at least a very long period without frost. These are widely distributed in C. And S. Europe and may reach N. Europe along the W. coasts and in Denmark (see list above).

On the N. slopes of the Elburz there is a great deviation in winter temperatures at different levels. There are also many different local climatic conditions (Probst, 1974). As a matter of fact, the variation in climate within the small area covered by the Caspian forests is almost as great as within the whole nemoral zone in Europe.

At higher altitudes in the Elburz mountains (1000 - 1500 m. s.m.), where the winters are cold, there are almost pure *Fagus*-forests. Among the wood-fungi collected there, even 89 % are common to N. Europe.

SUBSTRATE SPECIFICNESS: A main difference in the choice of substrate is between fungi growing on wood from coniferous and deciduous trees.

In Iran there are no natural conifer forests. Among fungi growing on deciduous trees, substrate specificness is not very pronounced but does occur for instance for wood-fungi on *Quercus* spp. It is also more common among fungi infecting living trees and those which fructificate on still-attached branches and twigs that are dead - but perhaps were alive when infected.

Within the nemoral zone, the substrate spectrum for certain wood-fungi generally decreases towards the north. This is illustrated by *Peniophora lilacea*, which in N. Europe is mostly found on *Ulmus carpinifolia*, *Fomes fomentarius* on *Fagus silvatica* and *Betula* spp, *Trametes gibbosa* on *Fagus silvatica*, *Phylloporia ribis* on *Ribes* spp and *Hirneola auricula-judae* on *Sambucus nigra*. In C. and S. Europe as well as in N. Iran, these species grow on a variety of lignose plants. This decrease in the number of possible substrates probably depends on competition from other wood-fungi.

A conclusion regarding the geographical distribution of wood-fungi in the nemoral zone in Europe must be that the temperature factor sets the main limits, within which there are several factors regulating the distribution, involving substrate specificness, competition with other wood-fungi and, generally, the occurrence of the special ecological niches required.

NOTES ON HABITATS. These notes are based on my own collections made during the periods 1 - 19th July, 1976 (Hallenberg 1978, 1979) and 26th April - 13th May, 1978 (Hallenberg 1980).

A. In most cases it was impossible to determine the substrate, but the following species and genera were noted:

Acer velutinum
Alnus
Buxus hyrcana
Carpinus
Crataegus
Diospyros lotus
Fagus orientalis
Gleditsia caspica
Mespilus germanica
Parrotia persica
Populus
Prunus
Pterocarya fraxinifolia
Quercus castaneifolia
Rosa
Ulmus

In the "list of species", below these substrates are mentioned only by their generic names.

B. Species exclusively found on, or preferring *Quercus castaneifolia* as substrate:

Peniophora quercina
Xylobolus frustulatus
X. subpileatus
Tomentella chlorina
Daedalea quercina
Gloeoporus dichrous
Nigroporus niger
Hymenochaete rubiginosa
Inonotus cuticularis
I. nidus-pici
Phellinus contiguus

C. The following species were collected on *Buxus hyrcana*:

Cystostereum subabruptum
Hyphodontia juniperi
Peniophora proxima
Ceriporia alachuana
Irpex lacteus
Schizopora carneo-lutea
Phellinus punctatus

D. Wood-fungi which seem to be more or less restricted to trunks and logs:

Gloeocystidiellum lactescens
Laeticorticium roseum
Phlebia centrifuga
Xylobolus frustulatus
X. subpileatus
Scytinostroma galactinum
Coniophora puteana
Tomentella chlorina
Antrodia lindbladii
Gloeoporus pannocinctus
Perenniporia medulla-panis
Trichaptum biforme
Laetiporus sulphureus

E. Wood-fungi which have been collected only on fallen or still-attached branches and twigs:

Auriculariopsis ampla
Ceratobasidium cornigerum
Gloeocystidiellum porosum
Phanerochaete martelliana
P. tuberculata
Phlebia albida

Hyphodontia crustosa
Peniophora cinerea
P. lilacea
P. lycii
P. pseudonuda
P. quercina
Stereum rameale
Trechispora fibrillosa
Vuilleminia comedens
V. cystidiata
Incrustoporia nivea
Hymenochaete cinnamomea

F. Frequent species fructificating on live or dead standing trees or on stumps:

Daedalea quercina
Fomes fomentarius
Fomitopsis pinicola
Polyporus squamosus
Rigidoporus ulmarius
Trametes gibbosa
Ganoderma australe
G. lucidum
Phellinus igniarius
P. pomaceus
P. torulosus
Phylloporia ribis

NOTES ON PERIODS OF FRUCTIFICATION AND ON THE MYCOFLORA IN MOUNTAIN FAGUS-FORESTS.

G. Species occurring much more frequently in the summer collection (1976) than that made in the spring (1978):

Gloeocystidiellum porosum
Hyphoderma transiens
H. sambuci
Mycoacia uda
Peniophora lycii
Phanerochaete aculeata
P. radulans
Phlebia rufa
Phlebiopsis roumeguerei
Trechispora fibrillosa
Rigidoporus ulmarius
Ganoderma australe
G. lucidum
Hymenochaete rubiginosa
Phellinus torulosus
P. contiguus

H. Species much more frequent in the spring collection (1978) than in the July one (1976). Those marked "F" were more or less restricted to the mountain Fagus-forest.

Athelia epiphylla F
Cystostereum subabruptum F
Dacryobolus sudans F
Hyphoderma setigerum
Hyphodontia crustosa
Lopharia spadicea
Peniophora incarnata
P. pseudonuda
P. lilacea
P. quercina
Phlebia caspica F
P. centrifuga F
P. livida
Radulomyces molaris
Scopuloides hydnoides F
Subulicystidium longisporum
Vuilleminia comedens
Tomentella chlorina
Bjerkandera adusta
Polyporus arcularius
Schizopora paradoxa
Trametes hirsuta
T. pubescens
Tyromyces gilvescens
Auricularia mesenterica
Hirneola auricula-judae
Bourdotia galzinii
Eichleriella spinulosa
Exidiopsis grisea
Tulasnella eichleriana

I. Except for those species marked "F" in the list above, the following frequent species were mainly found in the mountain Fagus-forest, while making the spring collection (1978):

Galzinia incrustans
Hyphodontia quercina
Peniophora cinerea
Sistotremastrum niveo-cremeum
Ceriporia purpurea

K. Besides, the following species were frequent in the mountain Fagus-forest but were also common in other parts of the Caspian forests:

Byssomerulius corium
Hyphoderma setigerum
Phanerochaete sordida
Phlebia livida
Sistotrema brinkmannii
Subulicystidium longisporum
Bjerkandera adusta
Schizopora carneo-lutea
S. paradoxa
Fomes fomentarius
Bourdotia galzinii
Exidiopsis grisea
Trametes gibbosa

LIST OF SPECIES. Frequent species collected in 1976 and 1978 are marked NH I and NH II and with the total number of my own collections given. When less than 4 collections/species, the collection numbers are noted.

Numbers below 2000 refer to 1976. For descriptions of new species and new combinations, see Hallenberg (1978, 1979, 1980). Records from the following authors are also included: Fallahyan (1973); Khabiri (1958); Niemelä & Uotila (1977), in the list marked "Niemelä"; Petrak (1939, 1949); Probst (1977); Rabenhorst (1871); Rostrup (1908); Saber (1972, 1974), marked "Saber I" and "Saber II" respectively; Soleimani(1975); Watling & Sweeney (1975). An unpublished collection by Probst is also included. In the list these authors are referred to by their names.

The collected material is deposited in GB and IRAN.

In the list below, the families of Aphyllophorales are treated in the following order: Corticiaceae, Coniophoraceae, Lachnocladiaceae, Thelephoraceae, Polyporaceae, Ganodermataceae, Hymenochaetaceae, Hericiaceae, Clavariaceae, Cyphellaceae, Fistulinaceae, Schizophyllaceae, Auriculariaceae, Tremellaceae, Dacrymycetaceae, and Tulasnellaceae. Within the families, the species are enumerated in alphabetical order.

CORTICIACEAE

Athelia arachnoidea (Berk.)Jül.
Gorgan. On fallen branches. NH 2357, 2369.

A. decipiens (v.Höhn. & Litsch.) John Erikss.
Gorgan. On a brown-rotted log. NH 2301, 2303.

A. epiphylla Pers.
Gorgan, Mazanderan. On fallen trunks, logs and branches of *Quercus*, *Fagus*, and indet. ligneous plants, on leaves, bark and mosses on the ground. NH II; 25 collections.

Athelia sp.
Gorgan. On a fallen branch. NH 2588 (see Hallenberg 1980).

Auriculariopsis ampla (Lév.) Maire
Gorgan. On a fallen twig. NH 2025.

Botrybasidium aureum Parm.
Gorgan, Mazanderan. On a fallen log and on a white-rotted trunk of *Fagus*. NH 1426, 2556.

B. botryosum (Bres.)John Erikss.
Mazanderan. On wood on the ground, on a branch, on a root of *Parrotia*. NH 1731, 1875, 2687.

B. candicans John Erikss.
Gorgan. On brown-rotted wood. NH 2377.

B. conspersum John Erikss.
Gorgan. On a decayed trunk on the ground. NH 2537.
N.B. Only the conidial state, *Haplotrichum conspersum* (Link)Hol.-Jech. is present in this collection.

B. curtisii Hallenb.
Gorgan, Mazanderan, Gilan. On fallen trunks and branches. NH I, II; 7 collections.

B. grandinioides Hallenb.
Mazanderan. On a fallen trunk. NH 1752.

B. laeve (John Erikss.)Parm.
Gilan. On a fallen branch. NH 1946.

B. obtusisporum John Erikss.
Gorgan. On a fallen trunk of *Parrotia*. NH 1402.

B. subcoronatum (v.Höhn. & Litsch.)Donk
Gorgan, Gilan. On branches and logs of *Quercus* and indet. ligneous plants. NH I, II; 7 collections

Botryohypochnus isabellinus (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, branches and twigs of *Carpinus*, *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 14 collections.

Brevicellicium olivascens (Bres.)Hjortst. & K.-H. Larss.
Syn.: *Trechispora mutabilis* (Pers.)Liberta
Gorgan. On a fallen branch. NH 2053 B.

Byssomerulius corium (Fr.)Parm.
Gorgan, Mazanderan. On fallen branches and twigs of *Parrotia*, *Carpinus*, *Fagus*, and indet.ligneous plants. NH I, II; 16 collections; Saber II, Probst.

Ceraceomerulius serpens (Fr.) Erikss. & Ryv.
Mazanderan. On a fallen branch of *Fagus*. NH 2852.

Ceraceomyces borealis (Rom.)Erikss. & Ryv.
Gorgan, Mazanderan. On a fallen, white-rotted trunk and on a root of *Carpinus*. NH 2330; Probst.
N.B. The spores are somewhat short, 5.5 – 6.5 X 1.8 – 2 µm (Erikss. & Ryv., 1973: 6 – 8 X 1.8 – 2 µm).

Ceratobasidium cornigerum (Bourd.)Rog.
Gorgan. On a hanging twig. NH 1627.

Chondrostereum purpureum (Fr.)Pouz.
Gorgan, Mazanderan, Tehran. On trunks, branches, twigs and stumps of *Alnus*, *Carpinus*, *Fagus*, *Populus*, *Prunus divaricata*, *P. domestica*, *P. spinosa*, *Quercus*, and indet. ligneous plants. NH 1757, 2028; Khabiri, Probst, Saber II, Soleimani.

Conferticium insidiosum (Bourd. & Galz.)Hallenb.
Syn.: *Gloeocystidiellum insidiosum* (Bourd. & Galz.)Donk
Gorgan. On white-rotted, fallen logs and a trunk. NH II; 7 collections.

C. ochraceum (Fr.)Hallenb.
Syn.: *Gloeocystidiellum ochraceum* (Fr.)Donk
The Elburz mountains. On dry twigs of *Pinus*. Rabenhorst.

Cristinia helvetica (Pers.)Parm.
Gorgan, Mazanderan. On fallen trunks, logs and branches of *Fagus*, *Quercus*, and indet. ligneous plants. NH I, II; 6 collections.

Cylindrobasidium evolvens (Fr.)Jül.
Gorgan, Mazanderan. On cut wood and on a stump of *Carpinus* and indet. ligneous plant. NH 2207, 2212; Probst.

Cystostereum heteromorphum Hallenb.
Mazanderan. On a fallen log of *Fagus*. NH 2712.

C. stratosum Hallenb.
Gilan. On a fallen log. NH 1925.

C. subabruptum (Bourd. & Galz.)Erikss. & Ryv.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches of *Buxus*, *Fagus*, and indet. ligneous plants. NH I, II; 10 collections.

Dacryobolus sudans (Fr.)Fr.
Gorgan, Mazanderan. On fallen branches of *Fagus* and indet. ligneous plants. NH I, II; 5 collections.

Dendrothele acerina (Fr.)Lemke
Gorgan. On the bark of a live *Acer*-tree. NH 2026.

Donkia pulcherrima (Berk. & Curt)Pil.
Gorgan, Mazanderan, Gilan. On trunks and branches of *Fagus* and indet. ligneous plants. NH I, II; 5 collections; Soleimani.

Fibrodontia gossypina Parm.
Gorgan, Mazanderan. On wood of *Fagus* and on a fallen trunk of *Quercus*. NH 2471, 2697.

F. subceracea Hallenb.
Gorgan, Gilan. On fallen branches and on white-rotted wood. NH I, II; 5 collections.

Fibulomyces septentrionalis (John Erikss.)Jül.
Gorgan. On a hanging branch. NH 1582.

Galzinia incrustans (v.Höhn. & Litsch.)Parm.
Gorgan, Mazanderan. On fallen twigs and branches of *Parrotia* and *Fagus*. NH I, II; 4 collections.

G. longibasidia Hallenb.
Gorgan. On fallen branches. NH 2403, 2417.

Gloeocystidiellum lactescens (Berk.)Boid.
Gorgan, Mazanderan. On fallen trunks and logs. NH I, II; 4 collections. N.B. NH 2564 has rather short spores, 5 – 6.5 X 4 – 5 µm (Erikss & Ryv, 1975:6 – 7 X 4 – 4.5 µm, Rattan, 1977: 5 – 7.5 X 4 – 5.5 µm).

G. porosum (Berk. & Curt.)Donk
Gorgan, Mazanderan, Gilan. On fallen twigs and branches of *Quercus*, *Fagus*, and indet. ligneous plants. NH I, II: 10 collections

Gloeodontia columbiensis Burt ex Burds. & Lomb.
Gorgan. On a fallen branch and a twig. NH 1478, 2529.

Hyphoderma argillaceum (Bres.)Donk
Gorgan, Mazanderan. On a branch and on a fallen, brown-rotted trunk. NH 2384; Probst.

H. cremeoalbum (v.Höhn. & Litsch.)Jül.
Mazanderan. On a fallen twig of *Fagus*. NH 2698.

H. echinocystis Erikss. & Strid
Gilan. On a fallen branch. NH 1933.

H. litschaueri (Burt)Erikss. & Strid
Mazanderan. On a fallen branch of *Fagus* . NH 2790.

H. mutatum (Peck)Donk
Gorgan. On a fallen twig. NH 1396.

H. pallidum (Bres.)Donk
Gorgan. On a fallen trunk. NH 2320.

H.praetermissum (Karst.)Erikss. & Strid.
Syn.: *H. tenue* (Pat.)Donk sensu auct.
Gorgan, Mazanderan, Gilan. On fallen logs and branches and on wood on the ground of *Fagus*, *Pterocarya*, *Quercus*, and indet. ligneous plants. NH I, II; 28 collections.

H. puberum (Fr.)Wallr.
Gorgan, Mazanderan. On fallen trunks, logs and branches of *Quercus* and indet. ligneous plant. NH I, II; 11 collections.

H. roseocremeum (Bres.)Donk
Mazanderan. On wood and branches of *Fagus* on the ground. NH 2647, 2702. N.B. NH 2647 deviates by somewhat narrower spores.

H. sambuci (Pers.)Jül.
Syn.: *Hyphodontia sambuci* (Pers.)John Erikss.
Rogersella sambuci (Pers.)Liberta & Navas
Gorgan, Mazanderan. On fallen logs, on fallen and hanging branches and twigs. NH I; 4 collections.

H. setigerum (Fr.)Donk
Gorgan, Mazanderan. On fallen logs and branches of *Fagus*, *Quercus*, and indet. ligneous plants. NH I, II; 19 collections.

H. transiens (Bres.)Parm.
Gorgan, Mazanderan, Gilan. On branches and twigs of *Buxus*, *Quercus*, and indet. ligneous plants. NH I, II; 5 collections.

Hyphodermella corrugata (Fr.)Erikss. & Ryv.
Syn.: *Odontia corrugata* (Fr.)Bourd. & Galz.
Gorgan. On fallen branches and twigs of *Crataegus* and indet. ligneous plants. NH I, II; 7 collections.

Hyphodontia arguta (Fr.)John Erikss.
Gorgan, Mazanderan. On a fallen trunk of *Fagus*, on fallen branches of indet. ligneous plants. NH 1773, 2481, 2764.

H. crustosa (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen logs, branches and twigs of *Diospyros*, *Fagus*, *Quercus*, and indet. ligneous plants. NH I, II; 22 collections.

H. nespori (Bres.)Erikss. & Hjortst.
Gorgan. On a fallen branch. NH 2410.

H. juniperi (Bourd. & Galz.)Erikss. & Hjortst.
Mazanderan. On fallen and hanging branches and twigs of *Buxus*. NH 1694, 1721.

H. quercina (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen twigs and branches of *Parrotia*, *Fagus*, and indet. ligneous plants. NH I, II; 10 collections.

H. quercina (Fr.)John Erikss. f. *coralloides* Hallenb.
Mazanderan. On a still-attached branch of *Fagus*. NH 2797.

H. spathulata (Fr.)Parm.
Gorgan. On wood and a branch on the ground. NH 2020, 2603, 2604.
N.B. The spores are smaller, 3.5 – 4 X 2.5 – 3 µm, than in European specimens (Erikss. & Ryv., 1976: 4.5 – 5.5 X 3.5 – 4 µm, Rattan, 1977: 4 – 5 X 3 – 3.5 µm).

H. subalutacea (Karst.)John Erikss.
Mazanderan. On fallen, white-rotted branches of *Fagus* NH 2755, 2786.

Hypochniciellum ovoideum (Jül.)Hjortst. & Ryv.
Syn.: *Leptosporomyces ovoideus* Jül.
Gorgan. On wood on the ground. NH 2484.

Hypochnicium caucasicum Parm.
Mazanderan. On a white-rotted stump of *Fagus*. NH 2684.

H. polonense (Bres.)Strid
Mazanderan. On a white-rotted, fallen log of *Fagus*. NH 2710.

Laeticorticium roseum (Fr.)Donk
Mazanderan. On a fallen log of *Fagus*, on *Quercus*. NH 2845; Probst.

Laxitextum bicolor (Fr.)Lentz
Gorgan, Mazanderan, Gilan. On a fallen trunk, branch and twig of *Fagus*, *Quercus* and *Carpinus*. NH 1652, 2666; Probst.

Lopharia spadicea (Fr.)Boid.
Gorgan, Mazanderan. On fallen branches and on a stump of *Carpinus*, *Fagus*, and indet. ligneous plants. NH I, II; 6 collections; Probst.

L. heterospora (Burt)Reid
Fars. On *Quercus brantii*. Probst.

Merulius tremellosus Fr.
Gilan. On a fallen branch. NH 1944.

Mycoacia aurea (Fr.)Erikss. & Ryv.
Syn.: *M. stenodon* (Pers.)Donk
Mazanderan. On fallen branches of *Pterocarya* and indet. ligneous plant. NH 1705, 1819.

M. uda (Fr.)Donk
Gorgan, Mazanderan, Gilan. On fallen logs, branches, twigs and on wood of *Parrotia*, *Fagus*, and indet. ligneous plants. NH I, II; 11 collections.

Mycoacia sp.
Gorgan. On a fallen branch. NH 2139 (see Hallenberg 1980).

Mycoaciella bispora (Stalpers)Erikss. & Ryv.
Gorgan, Mazanderan, Gilan. On fallen trunks and branches. NH I; 4 collections.

Oliveonia subfibrillosa Hallenb.
Gorgan, Mazanderan. On fallen trunks and on wood of *Quercus*, *Fagus*, and indet. ligneous plant. NH II: 2222, 2227, 2868.

Peniophora cinerea (Fr.)Cke
Gorgan, Mazanderan. On fallen branches and twigs of *Alnus*, *Buxus*, *Fagus*, *Parrotia*, and indet. ligneous plants. NH I, II; 22 collections. N.B. Fructifications mostly with well developed basal layers of densely united, brown hyphae.

P. incarnata (Fr.)Karst.
Gorgan, Mazanderan. On fallen logs, branches, twigs and on a stump of *Fagus*, *Carpinus*, *Alnus*, *Gleditsia*, and indet. ligneous plants. NH II; 5 collections; Probst, Saber II. N.B. Interfertility tests have been carried out between the Iranian specimens 2215, 2267 and LY 2481, from France. They were all positive.

P. lilacea Bourd. & Galz.
Gorgan. On fallen twigs and a branch. NH 2037, 2135, 2136.

P. lycii (Pers.)v.Höhn & Litsch.
Gorgan, Mazanderan. On fallen branches and twigs of *Crataegus*, *Diospyros*, *Parrotia*, indet. ligneous plants, and *Rosa*. NH I, II; 19 collections.

P. nuda (Fr.)Bres.
Gorgan. On fallen branches. NH 1504, 2361.

P. proxima Bres.
Gorgan, Gilan. On still-attached and fallen branches and twigs of *Buxus*. NH 1679, 1938.

P. pseudonuda Hallenb.
Gorgan, Mazanderan. On fallen and still-attached branches of *Fagus*, *Quercus*, *Parrotia*, and indet. ligneous plants. NH I, II; 8 collections.

P. quercina (Fr.)Cke
Gorgan, Mazanderan. On fallen and still-attached branches and twigs of *Quercus* and indet. ligneous plants. NH I, II; 8 collections; Probst.

P. quercina (Fr.)Cke f. *phlebioides* Hallenb.
Gorgan. On a fallen twig. NH 2051.

Peniophora violaceo-livida (Sommerf.)Mass.
Gorgan, Mazanderan. On fallen branches and twigs. NH 1503, 1702.

Peniophora sp.
Mazanderan. On a fallen branch. NH 1858 (see Hallenberg 1978).

Phanerochaete aculeata Hallenb.
Gorgan, Mazanderan. On fallen logs and branches. NH I; 4 collections.

P. macrocystidiata Hallenb.
Gorgan. On a fallen log. NH 1618.

P. martelliana (Bres.)Erikss. & Ryv.
Gorgan. On fallen twigs and a branch. NH 1602, 2399, 2422.

P. radulans Hallenb.
Syn.: Acia subochracea (Bres.)sensu Bourd. & Galz.
Gorgan, Gilan. On fallen trunks, logs and branches of Pterocarya and indet. ligneous plants. NH I, II; 5 collections.

P. raduloides Erikss. & Ryv.
Gorgan, Mazanderan. On fallen logs, branches and twigs of Fagus and indet. ligneous plants. NH I, II; 4 collections.

P. septocystidia (Burt)Erikss. & Ryv.
Gorgan, Gilan. On fallen branches of Parrotia and indet. ligneous plant. NH 1443, 1884.

P. sordida (Karst.)Erikss. & Ryv.
Syn.: P. cremea (Bres.)Parm.
Gorgan, Mazanderan. On fallen logs, branches and twigs of Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 25 collections; Petrak, Probst.

P. tuberculata (Karst.)Parm.
Gorgan. On fallen branches and twigs of Quercus and indet. ligneous plants. NH I, II; 12 collections.

P. velutina (Fr.)Erikss. & Ryv.
Gorgan, Mazanderan. On fallen trunks and branches of Fagus, Carpinus, Quercus, and indet. ligneous plant. NH I, II; 4 collections.

Phlebia albida v.Post in Fr.
Gorgan, Mazanderan. On fallen branches and twigs of Quercus and indet. ligneous plants. NH I, II; 9 collections.

P. caspica Hallenb.
Gorgan, Mazanderan. On fallen trunks and branches of Fagus and indet. ligneous plants. NH II; 6 collections.

P. centrifuga Karst.
Mazanderan. On fallen logs of Fagus. NH 2776, 2777.

P. lindtneri (Pil.)Parm.
Syn.: P. meruloidea Parm.
Gorgan. On a fallen branch. NH 1441.

P. livida (Fr.)Bres.
Gorgan, Mazanderan, Gilan. On logs, branches and twigs of Fagus, Pterocarya, and indet. ligneous plants. NH I, II; 14 collections.

P. rufa (Fr.)Christ.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches and twigs

of *Fagus*, *Carpinus*, *Parrotia*, and indet. ligneous plants. NH I, II; 21 collections.

Phlebia subochracea (Bres.)Eriks. & Ryv.
Gorgan, Mazanderan. On fallen branches and twigs and on wood of *Fagus* and indet. ligneous plants. NH I, II; 4 collections.
N.B. Two specimens, earlier reported as *P. segregata* coll. (Hallenberg 1978) belong to this taxon.

Phlebiopsis roumeguerei (Bres.)Erikss. & Hjortst.
Syn.: *Phlebia roumeguerei* (Bres.)Donk
Gorgan, Mazanderan, Gilan. On a fallen trunk, log and branches, on still-attached branches and twigs, on a stump and on wood on the ground of *Parrotia*, *Pterocarya*, *Quercus*, and indet. ligneous plants. NH I, II; 24 collections.

Pulcherricium coeruleum (Fr.)Parm.
Gorgan. On a fallen log of *Quercus*. NH 2505.

Radulomyces confluens (Fr.)Christ.
Gorgan, Mazanderan. On fallen logs, branches and twigs, on a still-attached twig of *Alnus*, *Buxus*, *Quercus*, and indet. ligneous plants. NH I, II; 14 collections

R. molaris (Fr.)Christ.
Gorgan. On a fallen log, twig and branches of indet. ligneous plants, on a still-attached branch of *Quercus*. NH I, II; 7 collections.

Scopuloides hydnoides (Cke & Mass.)Hjortst. & Ryv.
Syn.: *Phlebia hydnoides* (Cke & Mass.)Christ.
Gorgan, Mazanderan. On fallen trunks, logs and branches of indet. ligneous plants, on a deal of *Fagus*. NH I, II; 10 collections.

Sistotrema brinkmannii (Bres.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood on the ground of *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 27 collections.
N.B. One specimen (NH 2325) deviates by the presence of long, widened hyphal ends, protruding from the apices of aculei (see Hallenberg 1980).

S. camshadalicum Parm.
Gorgan. On a fallen branch. NH 1556.

S. commune John Erikss.
Gorgan. On a fallen branch. NH 2190.

S. coroniferum (v.Höhn. & Litsch.)Donk
Mazanderan. On a fallen branch of *Fagus*. NH 2753.

S. diademiferum (Bourd. & Galz.)Donk
Gorgan, Mazanderan. On a fallen log, branch and twigs of *Fagus*, *Parrotia*, and indet. ligneous plants. NH I, II; 5 collections.

S. oblongisporum Christ. & Hauersl.
Gorgan. On burnt wood. NH 2302.

S. raduloides (Karst.)Donk
Gorgan. On a fallen branch. NH 2269.

S. resinicystidium Hallenb.
Gorgan. On brown-rotted wood of *Quercus* on the ground. NH 2104, 2105, 2466.

Sistotrema suballantosporum Hallenb.
Gorgan. On decayed wood on the ground. NH 2019.

Sistotrema sp.
Gilan. On a fallen twig. NH 1885 (see Hallenberg 1978).

Sistotremastrum niveo-cremeum (v.Höhn. & Litsch.)John Erikss.
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on wood of Fagus and indet. ligneous plants. NH I, II; 17 collections.

Steccherinum fimbriatum (Fr.)John Erikss.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood on the ground of Fagus, Quercus, and indet. ligneous plants. NH I, II; 8 collections; Probst.

S. ochraceum (Fr.)S.F. Gray
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on still-attached branches and twigs of Fagus, Parrotia, Quercus, and indet. ligneous plants. NH I, II; 17 collections.

S. robustius (John Erikss. & Lundell)John Erikss.
Gorgan. On a fallen log. NH 2590.

Stereum hirsutum (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Fars, Azerbaidjan. On fallen and leaning trunks and logs, on fallen and still-attached branches and twigs of Acer, Alnus, Carpinus, Diospyros kaki, Fagus, Gleditsia, Parrotia, Quercus, Ulmus, Vitis, and indet. ligneous plants. NH I, II; 28 collections; Niemelä, Probst, Rabenhorst, Saber II, Soleimani.

S. gausapatum (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Fars. On fallen branches and on a stump of Quercus castaneifolia, Q. brantii, and indet. ligneous plants. NH 2036, 2125; Probst, Watling & Sweeney.

S. insignitum Quél.
Gilan, Mazanderan. On fallen logs of Fagus and on a still-attached branch of indet. ligneous plant. NH 1852, 2676, 2871; Probst, Rabenhorst.

S. rameale (Pers.)Fr.
Gorgan. On a fallen twig of Quercus. NH 1356.

S. subtomentosum Pouz.
Gorgan. Mazanderan, Gilan. On fallen trunks, logs and branches, on a still-attached branch of Carpinus, Fagus, and indet. ligneous plants. NH I, II; 6 collections; Probst, Saber II.

Subulicystidium longisporum (Pat.)Parm.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs, on wood of Acer, Crataegus, Fagus, Quercus, and indet. ligneous plants. NH I, II; 18 collections.

Trechispora alnicola (Bourd. & Galz.)Liberta
Gorgan, Mazanderan, Gilan. On fallen and still-attached branches and twigs of Pterocarya and indet. ligneous plants. NH I, II; 9 collections.

T. confinis (Bourd. & Galz.)Liberta
Gorgan, Mazanderan. On fallen branches of Fagus and indet. ligneous plants. NH 2149, 2530, 2709.

Trechispora dimitica Hallenb.
Gorgan. On a fallen branch. NH 2328.

T. farinacea (Fr.)Liberta
Gorgan, Mazanderan. On fallen trunks, logs and branches of Buxus, Fagus, Quercus, and indet. ligneous plants. NH I, II; 9 collections.

T. fibrillosa Hallenb.
Gorgan, Mazanderan. On fallen branches and twigs of Carpinus, Diospyros, and indet. ligneous plants. NH I, II; 10 collections. N.B. One specimen (NH 2053 A) was growing close to Brevicellicium olivascens (Bres.)Hjortst. & K-H Larss.

T. granulifera Hallenb.
Gorgan, Gilan. On a fallen trunk and log of Parrotia and Quercus. NH 1885, 2449.

T. microspora (Karst.)Liberta
Gorgan. On a fallen log and branches of Quercus and indet. ligneous plants. NH I, II; 4 collections.

T. mollusca (Fr.)Liberta
Gorgan. On a fallen log of Quercus. NH 2498.

T. praefocata (Bourd. & Galz.)Liberta
Mazanderan. On a fallen trunk of Fagus. NH 2725.

T. vaga (Fr.)Liberta
Syn.: Cristella sulphurea (Fr.)Donk
Gorgan, Mazanderan. On a fallen log and branches of Fagus and indet. ligneous plants. NH 1448, 1711, 2830.

Tubulicrinis incrassatus Hallenb.
Gorgan. On fallen branches. NH 1491, 1517.

T. thermometrus (Cunn.)Christ.
Mazanderan. On brown-rotted wood of Fagus. NH 2791

Uthatobasidium fusisporum (Schroet.)Donk
Gorgan. On a fallen branch of Parrotia. NH 1312.

Vuilleminia comedens (Fr.)Maire
Gorgan, Mazanderan. On fallen and still-attached branches and twigs of Fagus, Quercus, and indet. ligneous plants. NH II; 6 collections.

V. cystidiata Parm.
Gorgan. On fallen and still-attached branches and twigs of Crataegus, Mespilus germanica, and indet. ligneous plants. NH I, II; 4 collections.

V. megalospora (Bres.)Bourd. & Galz.
Gorgan. On a thin, still-attached branch. NH 2156.

Xenasma pruinosum (Pat.)Donk
Gorgan. On fallen branches of Parrotia and indet. ligneous plant. NH 1290, 1579.

X. pulverulentum (Litsch.)Donk
Gorgan. On a fallen branch. NH 1434.

Xenasmatella allantospora Oberw.
Gorgan, Mazanderan. On fallen branches and on wood of Fagus and indet. ligneous plants. NH 1850, 2003, 2631.

Xenasmatella grisella (Bourd.)Oberw.
Gorgan, Mazanderan. On fallen branches of *Fagus* and indet. ligneous plant. NH 2491, 2883. N.B. Spores somewhat larger (up to 6.5 X 3 µm) than in typical specimens (according to Oberwinkler /1965/ 4 - 5 X 2 - 3 µm). These specimens thus occupy an intermediate position between *X. grisella* and *X. ralla* (Jacks.)Oberw. As the separation of these two species is uncertain (Oberwinkler 1965), I prefer the oldest name for these specimens.

X. tulasnelloidea (v.Höhn. & Litsch.)Oberw. ex Jül.
Gorgan, Mazanderan, Gilan. On decayed wood, fallen trunks, logs, branches and twigs of *Alnus, Carpinus, Fagus, Parrotia, Quercus,* and indet. ligneous plants. NH I, II; 23 collections.

Xylobolus frustulatus (Fr.)Boid.
Gorgan, Mazanderan. On fallen and leaning trunks and logs of *Quercus*. NH I, II; 8 collections.

X. subpileatus (Berk. & Curt.)Boid.
Gorgan, Mazanderan. On fallen and leaning trunks and logs of *Quercus*. Probst also reports *Fagus* and *Carpinus* as substrates. NH I, II; 9 collections; Probst.

CONIOPHORACEAE

Coniophora puteana (Fr.)Karst.
Gorgan, Mazanderan. On brown-rotted, fallen trunks and a log of *Quercus*. NH I, II; 5 collections.

LACHNOCLADIACEAE

Scytinostroma galactinum (Fr.)Donk
Mazanderan. On fallen trunks of *Fagus*. NH 2764, 2867.

S. odoratum (Fr.)Donk
Gilan. On a fallen branch. NH 1917.

Vararia ochroleuca (Bourd. & Galz.)Donk
Gorgan. On fallen trunks of *Quercus*. NH 2559, 2560.

THELEPHORACEAE

Tomentella bryophila (Pers.)M.J.Larsen
Gorgan. On wood on the ground. NH 2533.

T. chlorina (Mass.)Cunn.
Syn.: *Amaurodon viride* (Fr.)Schroet.
Gorgan, Mazanderan. On decayed, fallen logs and trunks of *Fagus, Quercus,* and indet. ligneous plants. NH I, II; 11 collections. N.B. This species was especially common on fallen, brown-rotted trunks of *Quercus* during the spring collection (1978).

T. crinalis (Fr.)M.J.Larsen
Mazanderan. On a fallen branch NH 1778.

T. ferruginea (Pers.)Pat.
Gorgan. On a fallen branch. NH 1458.

Tomentella ferruginella Bourd. & Galz.
Gorgan. On a fallen branch. NH 1578.

T. neobourdotii M.J.Larsen
Gorgan. On a fallen twig. NH 1569.

T. ochracea (Sacc.)M.J.Larsen
Mazanderan. On a fallen branch and twig. NH 1774, 1827.

Tomentellastrum floridanum (Ell. & Ev.)M.J.Larsen.
Gorgan, Gilan. On fallen branches. NH 1472, 1912.

POLYPORACEAE

Antrodia albida (Fr.)Donk
Gorgan. On fallen branches and twigs of *Parrotia* and indet. ligneous plants, on a dead standing tree. NH I, II; 8 collections.

A. lindbladii (Berk.)Ryv.
Syn.: *Poria cinerascens* (Bres.)Sacc.
Mazanderan. On a fallen trunk. NH 1836.

A. semisupina (Berk. & Curt.)Ryv.
Mazanderan. On a fallen branch and on a still-attached branch of *Fagus*. NH 2697, 2889.

Aurantioporus albo-rubescens (Bourd. & Galz.)Jahn
The Caspian forests. Fallhyan.

A. fissilis (Berk. & Curt.)Jahn
Gorgan. On a dead standing tree. NH 1547.

Bjerkandera adusta (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches of *Acer, Carpinus, Citrus, Fagus, Parrotia, Quercus,* and indet. ligneous plants. NH I, II; 13 collections; Fallahyan, Saber I, II, Soleimani, Watling & Sweeney.

B. fumosa (Fr.)Karst.
Mazanderan. On a fallen trunk. NH 1687.

Ceriporia alachuana (Murr.)Hallenb.
Gorgan, Mazanderan. On a fallen trunk and on fallen branches of *Buxus* and indet. ligneous plants. NH 1649, 1722, 1746.

C. excelsa (Lundell)Parm.
Mazanderan. On fallen branches. NH 1720, 1754.

C. purpurea (Fr.)Donk
Gorgan, Mazanderan. On fallen branches and twigs, on wood of *Diospyros, Fagus,* and indet. ligneous plants. NH I, II; 11 collections.

C. reticulata (Fr.)Donk
Mazanderan. On a fallen log, on a stump and on decayed wood of *Fagus*. NH 2683, 2773, 2864.

C. viridans (Berk. & Br.)Donk
Gorgan, Mazanderan, Gilan. On decayed trunks, logs and branches. NH I, II; 10 collections.

Cerrena unicolor (Fr.)Murr.
Gorgan. On fallen logs and branches of a leguminous bush and indet. ligneous plants, on a stump of *Quercus*. NH II; 4 collections.

Coriolopsis floccosa (Jungh.)Ryv.
Gorgan, Mazanderan. On a fallen log of *Fagus*, on fallen and hanging branches of *Acer* and indet. ligneous plants, on a stump. NH I, II; 6 collections.

C. gallica (Fr.)Ryv.
Syn.: *Polyporus extenuatus* Dur. et Mont.
Gorgan. On fallen trunks and branches of *Quercus* and indet. ligneous plants. NH I, II; 5 collections; Soleimani.

Daedalea quercina Fr.
Gorgan, Mazanderan, Gilan. On fallen trunks of *Parrotia* and *Quercus*, on a stump of *Quercus*. NH I, II; 4 collections; Saber I, Niemelä, Watling & Sweeney.

Daedaleopsis confragosa (Fr.)Schroet.
Gorgan, Mazanderan. On fallen branches of *Parrotia* and indet. ligneous plant. NH 1321, 1786. N.B. Two deviating specimens (NH 2515, 2691) are determined as *D. confragosa* s.l. by Ryvarden.

Datronia stereoides (Fr.)Ryv.
Mazanderan. On a fallen twig of *Fagus*. NH 2769.

Fomes fomentarius (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Azerbaidjan, Tehran, Kashan, Karadj. On fallen trunks and logs, on dead standing trees of mainly *Fagus*. Also recorded from *Acer*, *Alnus*, *Amygdalus*, *Carpinus*, *Parrotia*, *Populus*, *Quercus*, *Salix*, *Ulmus*. NH I, II; 18 collections; Khabiri, Niemelä, Saber I, II, Soleimani.

Fomitopsis pinicola (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen and leaning trunks and logs of *Carpinus*, *Fagus*, *Parrotia*, *Pterocarya*, and indet. ligneous plants. NH I, II; 4 collections; Saber I, Soleimani.

Gloeophyllum saepiarium (Fr.)Karst.
Mazanderan, Gilan. On dead wood of a coniferous tree. Soleimani.

Gloeoporus dichrous (Fr.)Bres.
Gorgan, Mazanderan, Gilan. On fallen logs and branches of *Acer*, *Carpinus*, *Fagus*, *Quercus* and indet. ligneous plants. Especially common on thin, white-rotted branches in dry half-closed *Quercus*-forests. NH I, II; 7 collections; Soleimani.

G. pannocinctus (Rom.)John Erikss.
Mazanderan. On a fallen trunk of *Carpinus*. NH 1839.

Grifola frondosa (Fr.)S.F. Gray
Mazanderan, Gilan. On *Fagus*, *Carpinus*. Soleimani.

Hapalopilus nidulans (Fr.)Karst.
Gorgan. On a fallen log and branches of *Quercus* and indet. ligneous plants. NH 1604, 2006, 2518.

Heterobasidion annosum (Fr.)Bref.
Syn.: *Fomes annosus* (Fr.)Cke
Karadj. On a living tree of *Pinus nigra*. Fallahyan, Soleimani.

Heteroporus biennis (Fr.)Laz.
Karadj. On dead wood of *Pinus eldarica*. Soleimani.

H. fractipes(Berk. & Curt.)Fidal
Gilan. On fallen branches NH 1872, 1893.

Incrustoporia nivea(Jungh.)Ryv.
Syn.: *Popyporus semipileatus* Peck
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of *Fagus*, *Gleditsia*, *Parrotia*, and indet. ligneous plants. NH I, II; 16 collections.

Irpex lacteus (Fr.)Fr.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs, on live standing trees of *Buxus*, *Citrus aurantium*, *C. vulgaris*, *C. limonia*, *Diospyros*, *Gleditsia*, *Quercus*, and indet. ligneous plants. NH I, II; 18 collections; Petrak, Saber I, Soleimani.

Junghunia nitida(Fr.)Ryv.
Mazanderan. On a fallen branch. NH 2851.

Laetiporus sulphureus (Fr.)Murr.
Mazanderan, Gilan, Karadj. On fallen brown-rotted logs of *Parrotia*, *Ulmus*, and indet. ligneous plant. NH 1821; Saber I, Soleimani.

Lenzites betulina (Fr.)Fr.
Mazanderan. On fallen logs of *Betula*, *Carpinus*, *Fagus*, *Pinus*. NH 2808; Niemelä, Soleimani.

L. warnieri Dur. & Mont.
Gorgan. Niemelä.

Meripilus giganteus (Fr.)Karst.
Mazanderan, Gilan. On a decayed root, on fallen logs of *Fagus* and *Quercus*. Saber I, Soleimani.

Nigroporus niger (Berk.)Ryv.
Gorgan. On a fallen trunk of *Quercus*. NH 2581.

Oxyporus latemarginatus (Dur. & Mont.)Donk
Mazanderan. On fallen branches of *Citrus aurantium* and indet. ligneous plant. NH 1767; Saber I.

O. populinus (Fr.)Donk
The Caspian forests. On living trees of *Acer*, *Carpinus*, *Fagus*, *Tilia*. Soleimani.

Perenniporia elongata (Overh.)Dom.
Gorgan. On a leaning trunk of *Quercus*. NH 1667.

P. fraxinea (Fr.)Ryv.
Syn.: *Fomitopsis cytisina* (Berk.)Bond. & Sing.
Mazanderan. On *Carpinus*, *Citrus* and *Quercus*. Saber I, Soleimani.

P. medulla-panis (Fr.)Donk
Gorgan. On fallen trunks, logs, a branch, and on a stump of *Quercus*. NH I, II; 5 collections.

P. tenuis (Schw.)Ryv. cfr.
Gorgan. On wood on the ground. NH 2569. N.B. According to Ryvarden (in lit.) this specimen could be a young specimen of *P. tenuis*. A comparison with North American material, det. by Lowe, shows no noticeable differences.

Piptoporus betulinus (Fr.)Karst.
The Caspian forests. On a living *Betula*-tree. Fallahyan, Soleimani.

Polyporus arcularius (Batsch.)Fr.
Syn.: *P. anisoporus* Del. & Mont.
organ, Mazanderan. On fallen branches and twigs of *Fagus*, *Quercus* and indet. ligneous plants. NH 10 collections; Niemelä, Soleimani.

P. picipes Fr.
The Caspian forest. On *Fagus*. Soleimani.
N.B. *P. picipes* is a synonym to both *P. melanopus* Fr. and *P. badius* (S.F. Gray)Schw. As I have not seen Soleimanis material, it is impossible to refer it to the right species.

P. squamosus Fr.
Gorgan, Gilan, Azerbaidjan, Karadj. On stumps and living trees of *Fagus*, *Fraxinus*, *Platanus*, *Populus*, *Prunus spinosa*, *Salix* and *Ulmus*. NH 2251, 2263; Khabiri, Saber I, II, Soleimani.

P. varius Fr.
Gorgan, Gilan. On fallen trunks and branches. NH 1323, 2389; Rostrup.

Poria lenis (Karst.)Sacc.
Mazanderan, Gilan. On a fallen branch and twig. NH 1898, 1910.

Pycnoporus cinnabarinus (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen logs and branches of *Fagus* and indet. ligneous plants. NH 2249, 2294, 2661; Saber I, Soleimani.

Pyrofomes demidoffii (Lév.)Kotl. & Pouz.
Gorgan. On a live standing tree of *Juniperus polycarpus* in steppe vegetation. NH 2133.

Rigidoporus ulmarius (Fr.)Imazeki
Gorgan, Mazanderan, Gilan. At the base of dead or live standing, old trees and on fallen trunks of *Acer*, *Alnus*, *Carpinus*, *Parrotia*, *Pterocarya*, *Ulmus*, and indet. ligneous plants. NH I, II; 11 collections; Niemelä, Saber I, II, Soleimani.

Schizopora carneo-lutea (Rodw. & Clel.)Kotl. & Pouz.
Syn.: *S. phellinoides* (Pil.)Donk
Poria pseudoobducens Pil.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches, twigs and on stumps of *Buxus*, *Carpinus*, *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 31 collections; Saber I, Probst.

S. paradoxa (Fr.)Donk
Gorgan, Mazanderan. On fallen logs, branches and twigs of *Fagus*, *Parrotia*, *Quercus*, and indet. ligneous plants. NH I, II; 32 collections.

S. trichiliae (van der Byl)Ryv. cfr.
Gorgan. On a fallen log. NH 2556.
Note: According to Ryvarden (in lit.) this specimen is microscopically identical with *S. trichiliae*. However, the pores are more split than in specimens from tropical - subtropical areas of Africa and America, where it is a widespread species.

Trametes cervina (Schw.)Bres.
Gorgan, Mazanderan. On a dead, standing tree of *Pterocarya*, on a stump of *Quercus*, on a fallen log of *Fagus*. NH 1776, 2337, 2723.

Trametes gibbosa (Pers.)Fr.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on stumps and dead standing trees of *Acer, Carpinus, Fagus, Parrotia,* and indet. ligneous plants. NH I, II; 15 collections; Khabiri, Saber I.

T. hirsuta (Fr.)Pil.
Gorgan, Mazanderan, Gilan. On fallen trunks, branches and twigs, on stumps of *Fagus, Populus,* and indet. ligneous plants. NH I, II; 10 collections; Niemelä, Saber I, Soleimani, Watling & Sweeney.

Trametes ljubarskyi Pil.
Gorgan. On a stump. NH 2248.

T. pubescens (Fr.)Pil.
Gorgan, Mazanderan. On fallen trunks, logs, branches and twigs of *Alnus, Fagus, Quercus,* and indet. ligneous plants. NH I, II; 12 collections; Niemelä, Saber I.

T. suaveolens (Fr.)Fr.
Gorgan. On a stump. NH 2298.

T. trogii Berk.
Gorgan, Mazanderan, Azerbaidjan, Tehran. On a stump, on live standing trees of *Populus, Salix,* and indet. ligneous plants. NH 1606, 2921, 2922; Saber I, Soleimani.

T. versicolor (Fr.)Pil.
Gorgan, Mazanderan, Gilan, Karadj. On fallen trunks, logs, branches, twigs and on stumps of *Carpinus, Citrus aurantium, Fagus, Parrotia, Platanus, Prunus, Quercus, Ulmus,* and indet. ligneous plants. NH I, II; 16 collections; Khabiri, Niemelä, Rabenhorst, Saber I, II, Soleimani, Watling & Sweeney.

T. zonatella Ryv.
Gorgan. On a live standing tree of *Crataegus.* NH 2092.

Trichaptum biforme (Fr.)Ryv.
Syn.: *Hirschioporus pargamenus* (Fr.)Bond. & Sing.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs, branches and on dead standing trees of *Carpinus, Fagus, Parrotia, Quercus,* and indet. ligneous plants. NH I, II; 17 collections; Niemelä, Saber I, II.

Tyromyces gilvescens (Bres.)Ryv.
Gorgan, Mazanderan. On fallen trunks and logs of *Fagus* and indet. ligneous plants. NH II; 5 collections.

T. hibernicus (Berk. & Br.)Ryv.
Syn.: *Polyporus subsericeomollis* Rom.
Gorgan, Mazanderan. On a fallen trunk of *Quercus* and on a branch. NH 1957, 2563.

T. lacteus (Fr.)Murr.
Mazanderan. On a fallen log of *Fagus,* on *Quercus, Ulmus.* NH 2872; Soleimani.

Tyromyces placenta (Fr.)Ryv. cfr.
Mazanderan. On a decayed stump. NH 1824. N.B. *T. placenta* is hitherto only known from coniferous wood. As this specimen was growing on deciduous wood the determination is uncertain.

GANODERMATACEAE

Ganoderma applanatum (S.F. Gray)Pat.
Gorgan, Mazanderan. On a stump of Fagus, on a root, on living and dead trees of Carpinus, Fagus, Gleditsia, and indet. ligneous plant. NH 2252; Saber I, Soleimani, Watling & Sweeney.

G. australe (Fr.)Pat.
Syn.: G. adspersum (Schulz.)Donk
G. europaeum Steyaert
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on dead standing trees of Carpinus, Citrus aurantium, Citrus sp., Diospyros kaki, Fagus, Gleditsia, Mespilus, Parrotia, Populus, Prunus spinosa, Prunus sp., Quercus, Tilia, and indet. ligneous plants. NH I, II; 11 collections; Saber I, II, Soleimani.

G. lucidum (Fr.)Karst.
Gorgan, Mazanderan, Gilan. On fallen logs and branches, on roots and stumps, on live standing trees of Carpinus, Diospyros, Parrotia, Quercus, Ulmus, and indet. ligneous plants. NH I, II; 8 collections; Khabiri, Saber I, Soleimani.

G. manoutchehrii Steyaert
Mazanderan. On Acacia. Steyaert.

G. resinaceum Boud. in Pat.
Mazanderan. On a dry root and on dry wood of Pterocarya and indet. ligneous plant. Saber I.

HYMENOCHAETACEAE

Coltricia spathulata (Hooker)Murr.
Mazanderan. On the ground. Niemelä.

Hymenochaete cinnamomea (Pers.)Bres.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of Fagus, Quercus, and indet. ligneous plants. NH I, II; 17 collections; Probst.

H. corrugata (Fr.)Lév.
Gorgan. On a fallen branch. NH 1485.

H. rubiginosa (Fr.)Lév.
Gorgan, Gilan. On fallen branches of Quercus and indet. ligneous plants. NH I; 5 collections.

H. tabacina (Fr.)Lév.
Gorgan. On a fallen trunk of Quercus. NH 2577.

Inonotus cuticularis (Fr.)Pil.
Gorgan, Mazanderan, Azerbaidjan, Karadj. On a stump of Quercus, on fallen trunks, on a living tree of Salix, Populus, and indet. ligneous plant. NH 1362. Saber I, Soleimani.

I. hispidus(Fr.)Karst.
Azerbaidjan, Karadj. On living trees of Ulmus campestris, Malus communis, Platanus. Fallhyan, Saber II, Soleimani.

I. nidus-pici Pil.
Gorgan. In a hollow in a live standing Quercus. NH 1350.

Inonotus obliquus (Fr.)Pil.
The Caspian forests. On dead wood. Soleimani.

I. pseudohispidus Kravts.
Tehran, Karadj. On living trees of *Platanus* and *Populus*. Soleimani.

Phellinus contiguus (Fr.)Pat.
Gorgan, Mazanderan. On fallen logs and branches of *Quercus* and indet. ligneous plants. NH I; 4 collections.

P. ferruginosus (Fr.)Pat.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on wood of *Carpinus, Fagus, Quercus,* and indet. ligneous plants. NH I, II; 15 collections.

P. igniarius (Fr.)Quél.
Gorgan. Mazanderan, Azerbaidjan. On dead and live standing trees, on stumps of *Carpinus, Crataegus, Fagus, Vitis,* and indet. ligneous plants. NH I, II; 4 collections: Saber II, Soleimani.

P. johnsonianus (Murr.)Ryv. cfr.
Gorgan. On a dead standing tree of *Parrotia*. NH 2096.
N.B. This specimen deviates from American one´s by hyaline spores instead of yellowish to pale rusty brown (Ryvarden in lit.).

P. pomaceus (Pers.)Maire
Gorgan, Mazanderan. On dead and live standing trees, on still-attached branches, on stumps of *Prunus* and indet. ligneous plants. NH II; 6 collections; Saber I, Soleimani.

P. punctatus (Fr.)Pil.
Gorgan, Mazanderan. On a fallen log of *Buxus,* on live standing trees of *Carpinus*. NH 1482, 1691, 1709.

P. robustus (Karst.)Bourd. & Galz.
The Caspian forests. On live standing trees of *Fagus* and *Quercus*.

P. torulosus (Pers.)Bourd. & Galz.
Gorgan, Mazanderan, Gilan. At the base of living trees and stumps of mainly *Parrotia*. Also found on *Crataegus* and *Quercus*. NH I, II; 7 collections; Probst (1977), Saber I, II, Soleimani.

Phylloporia ribis (Fr.)Ryv.
Syn.: *Phellinus ribis* (Fr.)Quél.
Gorgan, Azerbaidjan, Tehran. At the base of living trees, on stumps of *Crataegus, Populus, Prunus, Quercus, Salix,* and indet. ligneous plants. NH I, II; 4 collections; Saber II, Soleimani.

HERICIACEAE

Hericium coralloides (Fr.)Pers.
The Caspian forests. On dead trees of *Acer, Carpinus, Fagus, Fraxinus*. Soleimani.

CLAVARIACEAE

Mucronella calva (Fr.)Fr.
Gorgan, Mazanderan. On fallen logs and branches. NH 1563, 1685, 1971.

CYPHELLACEAE

Henningsomyces candidus (Fr.)Kunze
Syn.: Solenia candida Fr.
Gorgan, Mazanderan. On a fallen branch of Quercus, on wood on the ground. NH 1387, 1682, 2493.

Stigmatolemma poriaeformis (Fr.)Br. & Cke
Mazanderan. On a fallen log of Fagus. NH 2707.

Stromatoscypha fimbriata (Fr.)Donk
Mazanderan. On a fallen trunk of Fagus. NH 2759.

FISTULINACEAE

Fistulina hepatica Fr.
Mazanderan. On a live Quercus-tree. Soleimani.

SCHIZOPHYLLACEAE

Schizophyllum commune (Fr.)Fr.
Gorgan, Mazanderan, Gilan, Karadj. On fallen and hanging branches, twigs, on fallen trunks of Acer, Alnus, Carpinus, Citrus, Fagus, Morus albus, Populus, Quercus, Salix, and indet. ligneous plants. NH I, II; 5 collections; Niemelä, Petrak, Rabenhorst, Rostrup, Soleimani, Watling & Sweeney.

AURICULARIACEAE

Auricularia mesenterica (Dicks.)Pers.
Gorgan, Mazanderan, Gilan. On fallen trunks, logs and branches, on stumps of Fagus, Quercus, and indet. ligneous plants. NH I, II; 11 collections; Khabiri, Rabenhorst.

Helicogloea lagerheimi Pat.
Syn.: Saccoblastia sebacea Bourd. & Galz.
Gorgan, Mazanderan. On a fallen branch, on wood of Fagus.
NH 1467, 2668.

Hirneola auricula-judae (Hook)Underw.
Gorgan, Mazanderan. On fallen and leaning trunks, on branches of Fagus, Quercus, and indet. ligneous plants. NH I, II; 10 collections; Soleimani.

Saccoblastia sphaerospora Möller
Mazanderan. On fallen branches. NH 1783, 1785.

TREMELLACEAE

Basidiodendron cinereum (Bres.)Luck-Allen
Mazanderan. On a fallen branch, on wood of Fagus. NH 1838, 2740.

B. deminuta (Bourd.)Luck-Allen
Gorgan. On fallen branches. NH I, II; 4 collections.

Basidiodendron eyrei (Wakef.)Luck-Allen
Mazanderan. On a fallen branch of Fagus. NH 2624.

Bourdotia galzinii (Bres.)Bres. & Torr.
Gorgan, Mazanderan, Gilan. On fallen logs, branches, twigs, on stumps of Alnus, Fagus, Gleditsia, Quercus, and indet. ligneous plants. NH I, II; 35 collections.

Eichleriella spinulosa (Berk. & Curt.)Burt
Gorgan, Mazanderan. On fallen logs, branches and twigs, on a stump. Most common on Fagus. NH I, II; 9 collections.

Exidia glandulosa Fr.
Gorgan, Mazanderan. On fallen branches and twigs of Betula, Carpinus, Fagus, Parrotia, Quercus and indet. ligneous plants, on a still-attached twig of Celtis. NH I, II; 6 collections; Soleimani.

E. thuretiana (Lév.)Fr.
Mazanderan. On fallen branches of Fagus. NH 2622, 2882.

Exidiopsis grisea (Pers.)Bourd. & Maire
Syn.: E. effusa (Bref.)Möll.
Gorgan, Mazanderan. Mostly on fallen or still-attached, thin branches of Fagus, Parrotia, and indet. ligneous plants, on a fallen trunk of Fagus. NH II; 14 collections.

E. molybdea (Mc Guire)Ervin
Compared with the type.
Gorgan. On a leaning, brown-rotted trunk of Acer. NH 2086.

Heterochaetella dubia (Bourd. & Galz.)Bourd. & Galz.
Gorgan. On brown-rotted wood. NH 2522.

Myxarium podlachicum (Bres.)Raitv.
Syn.: Sebacina podlachica Bres.
Gorgan, Mazanderan. On a fallen log, on wood of Fagus. NH 2318, 2800.

Sebacina incrustans (Fr.)Tul.
Gorgan. On litter on the ground. NH 1379, 1488.

Tremella mesenterica Fr.
Gorgan, Mazanderan, Gilan. On fallen branches and twigs of Fagus and indet. ligneous plants. NH 2225, 2435, 2757; Soleimani.

DACRYMYCETACEAE

Calocera cornea Fr.
Gorgan, Mazanderan. On a fallen log and branch, on a deal. NH 1741, 2513, 2842.

Dacrymyces minor Peck
Gorgan. On a fallen branch. NH 2075.

TULASNELLACEAE

Tulasnella allantospora Wakef. & Pears.
Gorgan. On wood on the ground. NH 2360.

Tulasnella eichleriana Bres.
Gorgan, Mazanderan. On fallen trunks, logs and branches, on wood of *Fagus*, *Quercus*, and indet. ligneous plants. NH II; 8 collections.

T. violea (Quél.)Bourd. & Galz.
Gorgan, Mazanderan. On a fallen branch, on a fallen log of *Fagus*. NH 2262, 2736.

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The field-work in Iran was realized thanks to the generous help given from "Plant Pests and Diseases Research Institute", Tehran, and I am particularly grateful to Dr. D. Ershad and B. Danesh-Pashuuh who took responsibility for the planning and the practical arrangements for the field-work.

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Finally, I want to thank the Curators of the herbaria BPI, C, E, K, and P for having kindly placed material at my disposal.

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RÉCOLTE DE THUEMENELLA CUBISPORA AU GABON

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RÉSUMÉ

Thuemenella cubispora (Ellis & Holw.) Boedijn ne semble pas avoir été récolté depuis Seaver (1910). Une description et comparaison avec le typus en est faite d'après une récolte des environs de Libreville (Gabon).

SUMMARY

Thuemenella cubispora (Ellis & Holw.) Boedijn does not appear to have been collected since reported by Seaver (1910). A redescription is given from a collection taken in the Libreville, Gabon, area, and comparison was made with the type specimen.

G. Gilles le récolteur a pu observer les stromas jeunes: "Ils se présentent commes des petites masses abricot assez rouge de 2 à 3 mm de diamètre, érumpentes; puis ces masses grossissent en prenant une forme irrégulière et en devenant francement jaunes, les ostioles brunissent" (in litt. F.C., 23-VII-78).

Stromas mûrs 8-11 mm de large, 10-15 mm de long, de forme sinueuse et irrégulière, substipités, jusqu'à 5 mm d'épaisseur (Fig. 1). Surface veloutée laissant voir les ostioles sombres des périthèces (Fig. 2). Milieu du stroma à consistance cotoneuse (Fig. 3). Cet aspect velouté de la surface du stroma correspond à des éléments diverticulés (Fig. 4) de 50 à 60 µm de long, au dessus des périthèces, lesquels se trouvent au milieu d'un tissus pseudoparenchymateux composé de cellules à parois minces, irrégulièrement angulaires et globuleuses de 6-15 µm, devenant vers le milieu du stroma des hyphes flasques et lâches (Fig. 5) de 7 à 12 µm de diamètre. Périthèces enfoncés de 200-250 µm

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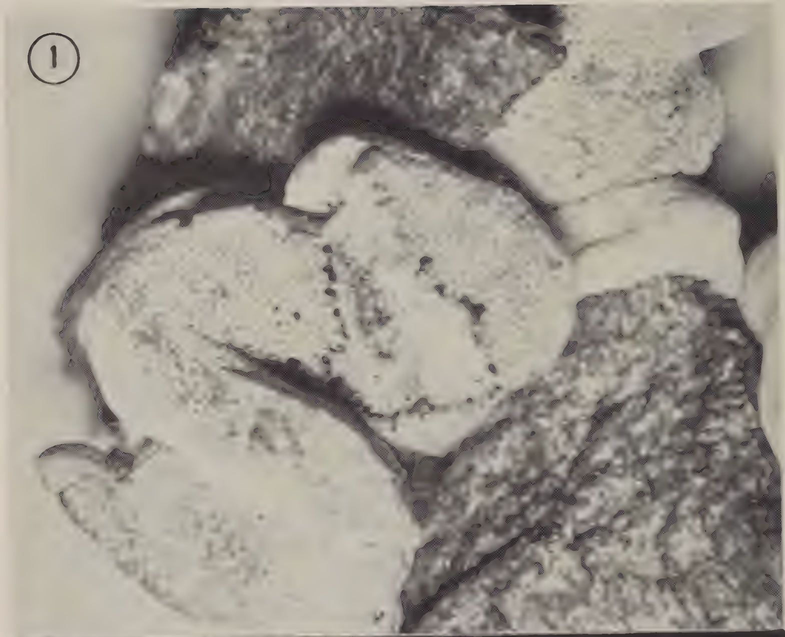
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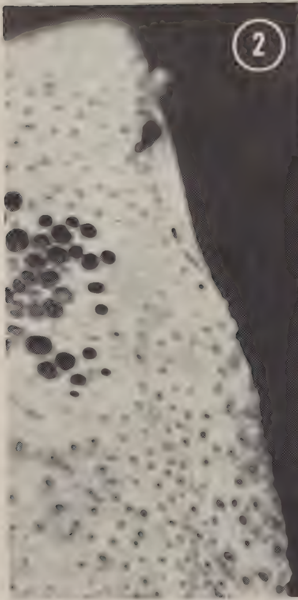
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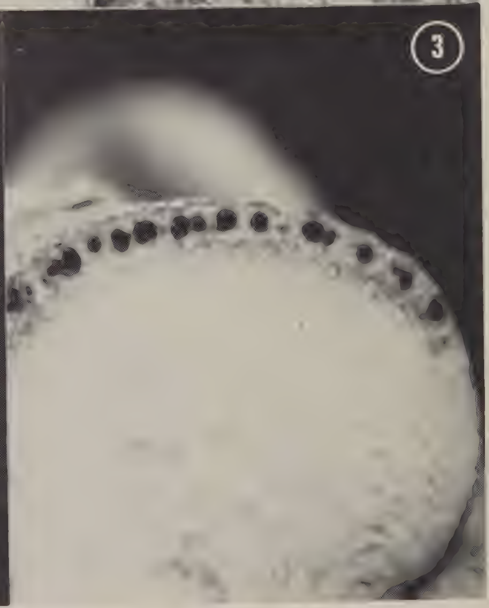
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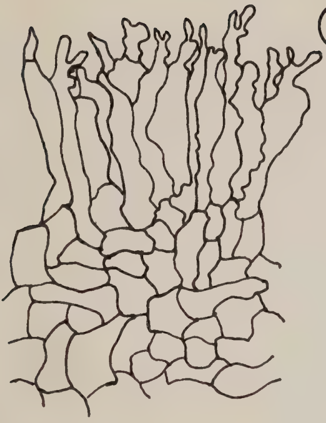

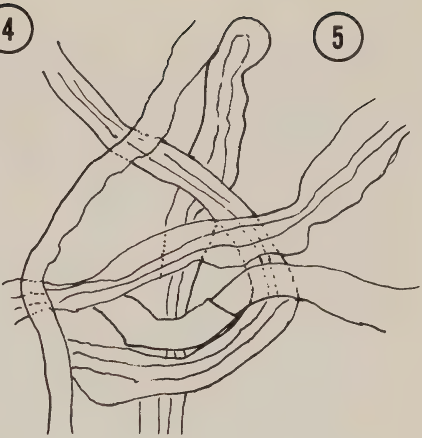

Fig. 4. Eléments diverticulés de la surface du stroma, x 600.
Fig. 5. Hyphes lâches de la partie inférieure du stroma, x 600.

à l'intérieur du stroma, sur un seul niveau (Fig. 3) dispersés irrégulièrement, globuleux 250-280 µm de diamètre, canal des ostioles 200-250 µm long. Asques 8 spores, naissant à la base des périthèces, courtement stipités, cylindriques, 60-65 × 5.0-5.5 µm, insensibles à l'iode. Spores unisériées, lisses, unicellulaires, de formes irrégulières soit angulaires, cubiques ou arrondies aux extémités, 5.5-7.0 × 3-4 µm, avec une ou deux guttules à l'intérieur, colorées sépia brun olive (Figs. 6, 7). Paraphyses d'environ 3µm de diamètre, rares, fragiles, incolores, se désagrégeant rapidement.

Récolte: G. Gilles, 23-VII-1978. A terre, sur écorce de branche morte. Forêt La Mondah, 27 km 200, Nord Libreville, Gabon. F.C. 4806-1 (= CUP 58816).

DISCUSSION

Nous avons déterminé cette récolte: Thuemenella cubispora (Ellis & Holway) Boedijn, sans trop de certitude, les descriptions de Seaver et d'Ellis & Holway étant

Figs. 1-3. **Thuemenella cubispora** (Ellis & Holw.) Boedijn. Fig. 1. Surface et forme du stroma, x 5. Figs. 2-3. Coupe horizontale et verticale laissant voir les périthèces, x 15

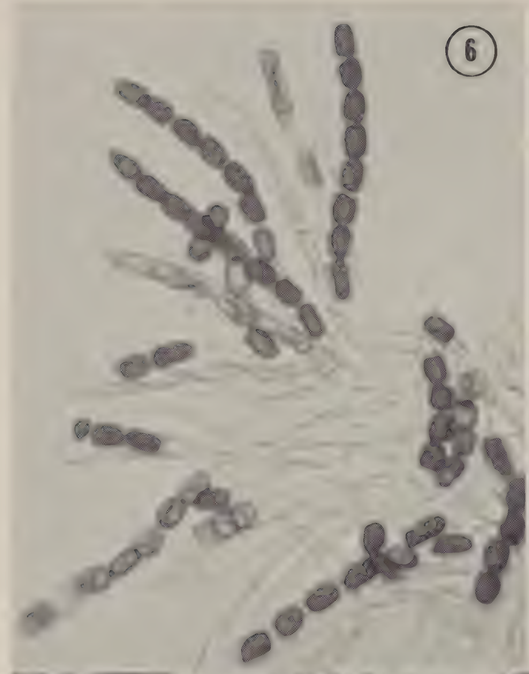

Fig. 6. Asques et spores, x 700.

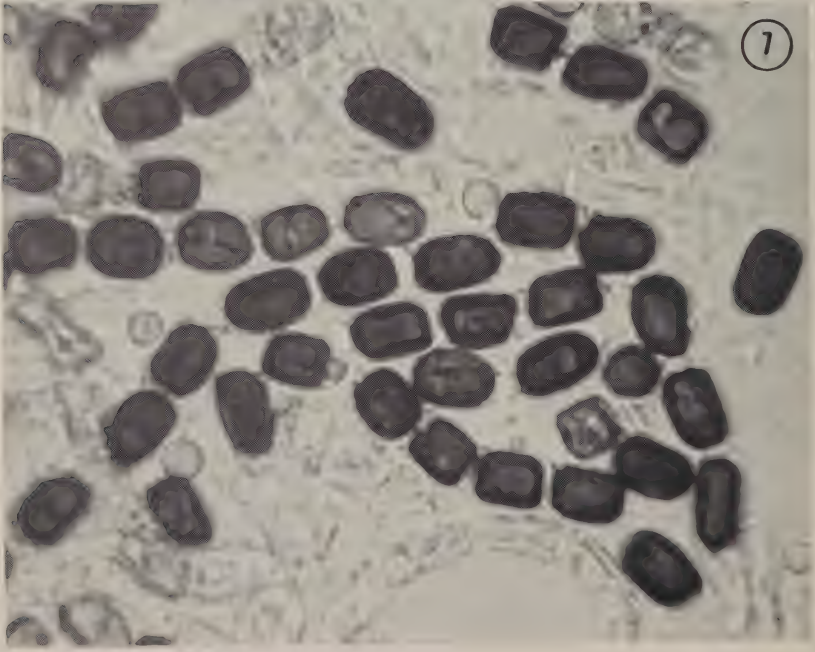

Fig. 7. Asques et spores, x 1400.

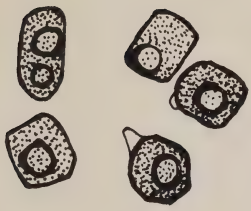

Fig. 8. Spores, x 1575.

insuffisantes. Nous avons demandé au Dr. G. Samuels (DSIR, Auckland, N.Z.) at au Dr. C. T. Rogerson (NYBG, Bronx, USA) de nous confirmer cette récolte et si possible de la comparer au typus. Ils ont bien voulu le faire et nous les en remercions vivement. Voici les conclusions du Dr. Clark Rogerson: "Dr. Gary Samuels and I finally have been able to compare the collection labelled Thuemenella cubispora (Ellis & Holway) Boedijn from Gabon (G. Gilles, 23/7/78) that you sent me. In all microscopic features the specimen matches the type collection of Hypocrea cubispora Ellis & Holway. The cuboid ascospores are the same size, shape and color and have smooth surfaces; the asci are 8-spored and are the same shape and size. The collection from Gabon does have a brighter color of the stroma, both outside and inside, and the immersed perithecia are more widely dispersed and are larger than in the type of H. cubispora (there is indication that this specimen may have been treated with alcohol or some other preservative before or after drying). We believe that the differences in stromatic features of color are not enough to modify your tentative identification. Seaver placed Hypocrea cubispora in his new genus Chromocreopsis stressing the 1-celled dark ascospores and 8-spored asci plus the stromatic characteristics. Boedijn synonymized Chromocreopsis with Thuemenella since both had been characterized by the dark, 1-celled ascospores. I tentatively maintained the two genera as distinct in my survey of the hypocrealean fungi stressing the cuboid ascospores in Chromocreopsis and the globose ascospores in Thuemenella. I have not had the opportunity to study this complex in detail but since the ascospores of the type species of both Chromocreopsis and Thuemenella have 1-celled, smooth-walled, dark ascospores, I would now accept Boedijn's synonymy. I have reservations as to whether or not the recently described species of Thuemenella are congeneric with its type. These species have warted ascospores and according to Doi the asci are 4-spored, the spores breaking apart to form 8 part spores.

"In summary, Dr. Samuels and I agree with your identification of the collection from Gabon as being

Thuemenella cubispora (Ellis & Holway) Boedijn." (in litt., F.C. 12-III-79).

Nous n'avons pu trouver dans nos connaissances un mycologue connaissant ou ayant récolté cette espèce. Le Dr. Y. Doi (TNS, Tokyo, Japon) ne l'a jamais récolté ni au Japon ni ailleurs (in litt., F.C. 26-9-78). Les professeurs R. P. Korf (CUP, Ithaca, USA) et J. Webster (University of Exeter, G.B.) non plus. Nous pensons qu'il s'agit d'une espèce très rare, apparemment connue jusqu'à présent de Iowa, Jamaique, et Gabon.

Nour remercions G. Gilles de cet envoi très intéressant, ainsi que Bruno Erb (Erlinsbach, Suisse) de nous en avoir fait les photos.

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GLOMUS ALBIDUS: A NEW SPECIES IN THE ENDOGONACEAE [1]

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SUMMARY

A new species in the Endogonaceae is described producing spores which fall into the morphological category of "white reticulate spore". The fungus is known to form vesicular-arbuscular mycorrhizae with onion, sorghum, and poplar.

INTRODUCTION

Separate investigations into the Endogonaceae and endomycorrhizae of Iowa and Ohio yielded the same undescribed species. This species has many of the characteristics ascribed to the "white reticulate" spore types of El-Giahmi et al. (1976), Hayman (1978), Mosse (1972), and Mosse & Bowen (1968a, 1968b). The spores are white, have a poorly defined subtending hypha at maturity, appear somewhat "reticulate" when viewed through a compound microscope, and germinate by production of a germ tube through the spore wall. The species is herein named *Glomus albidus* sp. nov. The Ohio isolate was established in pot culture on corn, and specimens from two such cultures were used for the type collection. The paratype is from a field collection from central Iowa.

GLOMUS ALBIDUS Walker and Rhodes sp. nov. Figure 1

Sporocarpia ignota. Chlamydosporae (85-)95-168(-198) x (85-)95-168 (-177) μm, globosae, subglobosae, ovoideae vel irregulares, luce reflexa hyalinae, albae vel albidae, luce transmissa luteae vel testaceae, hypha sustinenti una vel raro hyphis sustinentibus duobus. Tunica sporarum stratis duobus: exteriore 0.5-2 μm crasso, hyalino, ad maturitem fatiscenti et expanso in locos usque ad 8 μm, tum in parte exuto; interiore 0.5-2 μm crasso, flavo, subtiliter lamellato. Hypha affixa (3-)5-15 μm in diam, tunicis duobus, plerumque recta, simplex, et aperta, ad maturitem collabens.

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[1] Journal Paper No J-9693 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 2294.

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Sporocarps unknown. *Chlamydospores* under reflected light hyaline when young, white to off-white at maturity, always appearing yellowish to brownish-yellow by transmitted light through a compound light microscope. Spores with one subtending hypha (rarely with two subtending hyphae), borne singly in the soil on coenocytic hyphae. Mature spores (85-)95-168(-198) x (85-)95-168 (-177) μm, globose to subglobose, occasionally ovoid or irregular: cyanophilous in cotton blue at maturity, slowly and less strongly so in youth; mature spores becoming dull orange to yellow in Melzer's reagent, young spores becoming pink to orange-red.

Spore walls continuous with hyphal walls, clearly double in youth, consisting of an outer hyaline wall 0.5-2 μm thick, and an inner subequal finely laminated wall, light yellow and 0.5-2 μm thick. At maturity, the outer wall crumbling and expanding, becoming as much as 8 μm thick in places and rendering the spore opaque; then partly sloughing, often becoming less than 1 μm thick and having a roughened granular appearance.

Subtending hyphae 2-walled, outer wall thickened at spore base, (3-)5-15 μm wide, usually straight and simple, but sometimes constricted at the spore base or expanded by thickening of the outer wall to become slightly funnel-shaped. Occasionally with a bulging septum 5-20 μm distad of the pore, but usually open. Outer wall up to 0.7 μm thick, sloughing at maturity to leave the inner wall (0.2-0.5 μm thick) unsupported; hypha then shrivelling and collapsing, often becoming difficult to see.

Spore contents of crowded oil droplets, usually becoming angular from mutual pressure to give a reticulate appearance: seemingly sealed off by collapse of the subtending hypha at maturity.

Germination by germ tube penetrating the spore wall. Regrowth of the subtending hypha not observed.

Figure 1. Chlamydospores of *Glomus albidus*

(a) Mature spore (left) and immature spore (right) in juxtaposition.

(b) Young spore of *Gl. albidus*. Note the two distinct walls.

(c) A mature spore with the outer wall expanded (top) and sloughed (base).

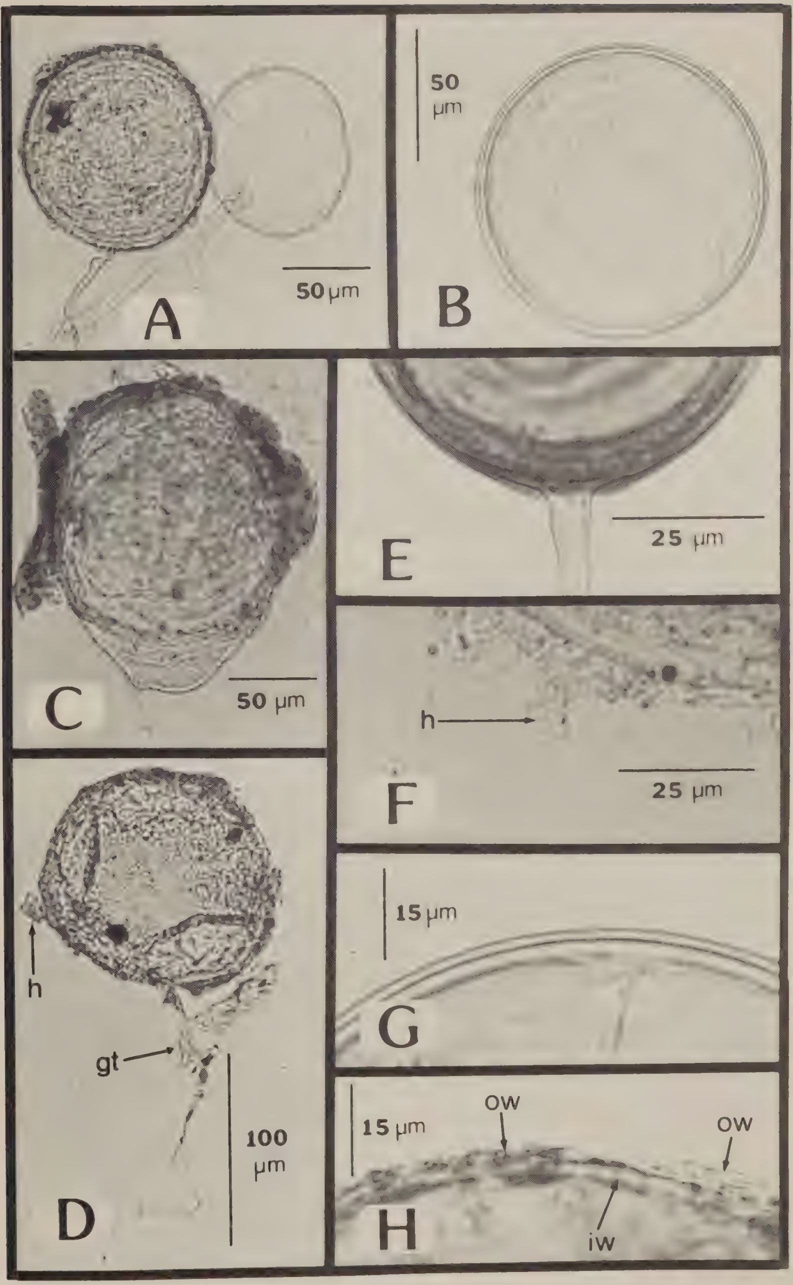
(d) Germinating spore. The germ tube (gt) has grown directly through the spore wall. The collapsed subtending hypha (h) is on the left.

(e) Detail of subtending hypha of a young spore. Note the two walls.

(f) Detail of subtending hypha of an old spore. The outer wall has disappeared and the hypha (h) has almost collapsed.

(g) Wall structure of a young spore. Two layers can clearly be seen.

(h) Wall structure of an old spore. The inner wall (iw) is intact, but the outer wall (ow) has crumbled and is breaking down.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DISTRIBUTION AND HABITAT

Known from the rhizosphere of winter wheat (*Triticum aestivum* L.) in Ohio, and from around the roots of grasses (*Setaria* spp. and *Bromus inermis* Leyss.) and poplars (*Populus* spp.) in an old meadow site in central Iowa. Found throughout the growing season. Probably also present in winter as resting spores in the soil and mycelium in living roots.

MYCORRHIZAL ASSOCIATIONS

Forming vesicular-arbuscular mycorrhizae with corn (*Zea mays* L.), onion (*Allium cepa* L.), sorghum (*Sorghum vulgare* Pers.), and poplar (*Populus* x *euramericana* (Dode) Guinier). Associated in the field with mycorrhizal roots of poplars, foxtail grasses (*Setaria* spp.), smooth brome (*B. inermis*), and wheat (*T. aestivum*).

ETYMOLOGY

Latin, *albidus*; whitish. Referring to the white to off-white appearance of the spores when viewed by reflected light.

COLLECTIONS EXAMINED

HOLOTYPE: OHIO - Pickaway Co (Collected by L H Rhodes, 6 vi 1977) among roots of winter wheat (*T. aestivum*). Type specimens from two pot cultures on corn (*Zea mays*), Walker #169, (OSC; isotype FH, ISC). *PARATYPE*: IOWA - Marshall Co, Rhodes, at the Iowa State University Rhodes Farm, Walker #179, 23 viii 1978 (ISC).

In addition, specimens from the Rhodes Farm were examined from random soil samples taken every two weeks during the summer and early autumn of 1978 as part of a population dynamics study of endogonaceous spores.

DISCUSSION

Mature spores of *Glomus albidus* are separated from those of other *Glomus* species by their white to off-white color and by their thin-walled, collapsed subtending hyphae. The change of color to yellowish when viewed through a compound microscope is also characteristic. *Gl. gerdemannii* Rose, Daniels & Trappe also has a very delicate subtending hypha, but, unlike *Gl. albidus*, the hypha is thickened for a short distance from the point of attachment. The outer wall of *Gl. albidus* and the middle wall of *Gl. gerdemannii* both appear firm in youth and then swell and break down as the spore matures. However, the breakdown of the former is into granular material, whereas the latter is into flaky pieces of laminations. *Glomus clarus* Nicolson & Schenck, and *Gl. occultus* Walker sp. ined. have hyaline to white spores possessing an outer coat which sloughs off with maturity. Both these species, however, lack the consistently whitish colour of *Gl. albidus* at maturity and have well-defined subtending hyphae at all stages of development (Nicolson & Schenck, 1979; C Walker, Iowa State University, in prep.).

Young spores of *Gl. albidus* are hyaline and can be confused with those of *Gl. occultus*, *Gl. clarus*, and *Gl. pallidus* Hall. *Glomus occultus* has a more complex wall structure than *Gl. albidus*, consisting of three layers, is generally much smaller (35-100 x 40-120 μm), and has a persistent subtending hypha which lacks an outer wall. The subtending hypha of *Gl. occultus* often is recurved, whereas the subtending hypha of *Gl. albidus* usually is straight. The walls of *Gl. clarus* spores are not of equal thickness, the outer wall being much thicker than the inner. The two walls of young spores of *Gl. albidus* are of almost equal thickness. In addition, young spores of *Gl. clarus* have a thin outer coat, tightly adhering to the outer wall, thus making three layers in all. The description of *Gl. pallidus* indicates that only one, laminated wall is present in that species (Hall, 1977), and even mature spores are much smaller than many of the immature specimens of *Gl. albidus* to be found in a collection. Finally, young spores of *Gl. albidus* have a characteristic pink to orange-red reaction to Melzer's reagent. *Gl. clarus*, *Gl. occultus*, and *Gl. gerdemannii* have no such reaction. The response of *Gl. pallidus* to this reagent is unknown.

Careful observation of a series of spores will allow all stages of development to be studied, making identification easier and more certain.

Glomus albidus is probably one of the "white reticulate" isolates referred to in the literature. However, Hall & Fish (1979) refer to Hayman's (1978) "white reticulate" species, and state that it is not the same as that of Mosse & Bowen (1968a, 1968b). The key of Hall & Fish (1979) indicates that Hayman's spore has projections 12-30 μm high on the outer wall. No such structures occur on *Gl. albidus*, and therefore it is not the same as that observed by Hayman (1978). The "white reticulate" spores described by Mosse & Bowen (1968a) apparently are similar to *Gl. albidus*, but one of us (Walker) has received spores from G D Bowen of an Australian "white reticulate" isolate, and these are not *Gl. albidus*. The "white reticulate" spores of El-Giahmi et al. (1976) and Mosse (1972) look very similar to *Gl. albidus*, but the descriptions are insufficient for conclusive identification. It is possible that several taxa have spores that could fall into the general morphological category of "white reticulate".

Consideration was given to raising a new genus to accommodate chlamydosporic species of the Endogonaceae that germinate through the spore wall, but there are good reasons for not doing so. The germination of many *Glomus* spp. has not been observed, and it therefore would be impossible to place such species to genus if germination mode was used as the sole generic criterion. At least one other species in *Glomus* (*Gl. pallidus*) is known to germinate through the spore wall (Hall, 1977), but in all other respects it clearly is a *Glomus* species. In the genus *Gigaspora*, there are two germination modes viz., with or without compartmentalization of spore contents prior to germ tube egress, but as yet there seems no justification for splitting the genus on germination characteristics. If *Glomus* were separated on such features, the same might justifiably be done for *Gigaspora*. It may be that, as more is learned about members of the Endogonaceae, subgenera will be erected based on mode of germination. The use of such characters for generic delimitation at present would lead to confusion rather than clarification.

Rose et al. (1979) referred to the similarities between *Gl. gerdemannii* and azygosporic species in *Gigaspora* and *Acaulospora*. There are two characteristics of *Gl. albidus* that could similarly be considered as evidence for a link between it and azygosporic species in the family. The germination directly through the spore wall, rather than by regrowth through the subtending hypha, is similar to that of *Gigaspora* and *Acaulospora*; and the reaction to Melzer's reagent is typical of the white-spored species in these two genera. However, there is no evidence of sexual or pseudosexual structures, such as the thin-walled hyphae on the mother vesicle of *Acaulospora* spp., or the small hyphal projection on the bulbous suspensor-like cell of *Gigaspora*.

ACKNOWLEDGMENTS

We wish to thank Dr James M Trappe and Dr Norman C Schenck for their helpful comments. Dr Trappe prepared the latin diagnosis, for which we thank him. Thanks are also due to Kathleen M Bason and Joan Zito for their help in preparing the photographic plate, and to Mrs E S Ellis and Mrs L Queen for preparing the camera-ready copy.

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ACAULOSPORA SPINOSA SP. NOV. WITH A KEY TO THE SPECIES OF *ACAULOSPORA*[*]

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Surveys of the Endogonaceae in Mexico by Trappe and Iowa by Walker revealed an undescribed taxon in the genus *Acaulospora*. The species is easily distinguished from all other known members of the genus.

ACAULOSPORA SPINOSA Walker & Trappe sp. nov. (Figs. 1-8)

Sporocarpia ignota. Sporae singillatim in terra enatae, sessiles, lateraliter gestae in hypha infundibuliformis vel cylindracea in vesiculam globosam prope terminata. Sporae 100-298 x 100 335µm, plerumque globosae vel subglobosae, interdum ellipsoideae vel reniformes, obscure avellaneae vel atrohiberae, spinis 1-4µm altis ornatae. Sporae tunica e stratis tribus, exteriore avellaneo vel atrohibero, 4-10µm crasso, medio et interiore hyalines, 0.2-1µm crassis.

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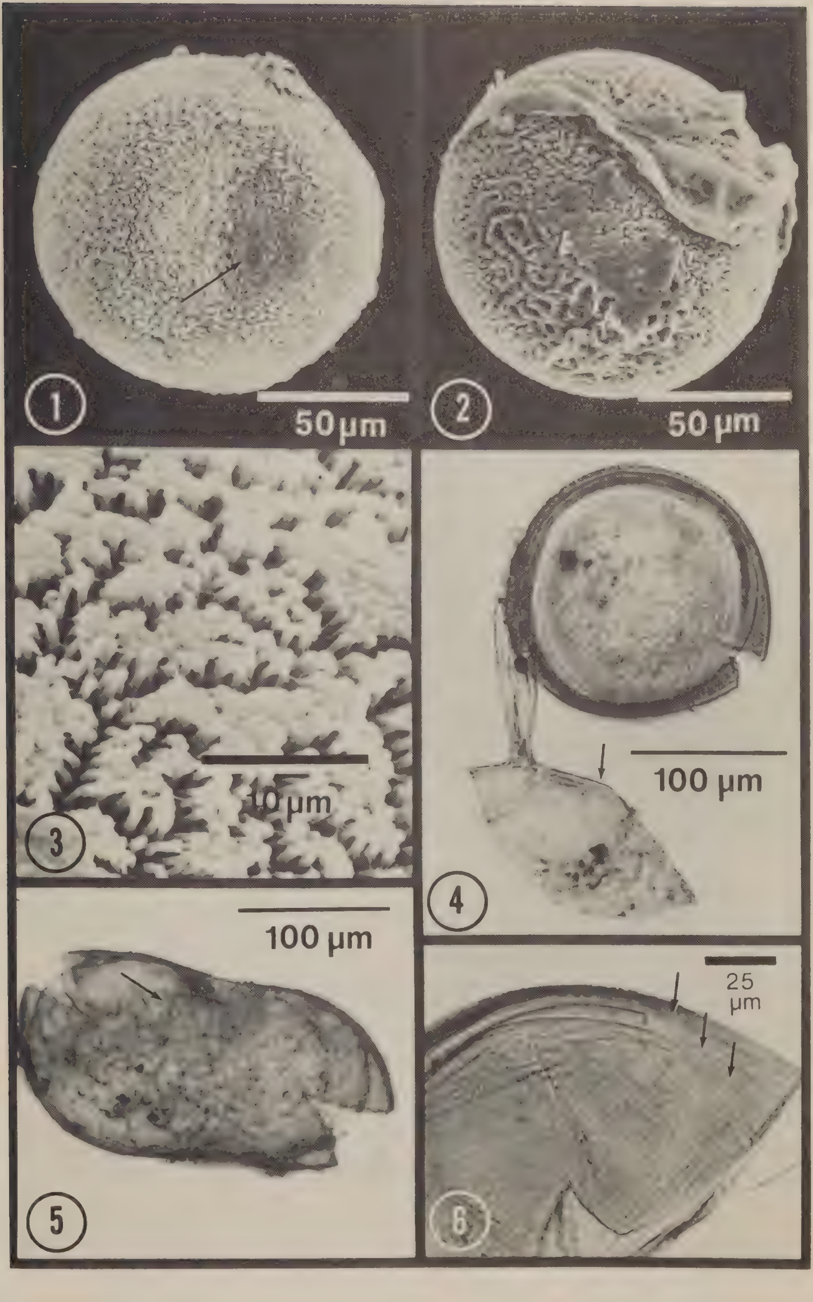
Sporocarps unknown. Azygospores formed singly in soil, sessile, attached by a collar 8-15µm broad to the side of a funnel-shaped to cylindrical hypha; hypha terminating in a globose vesicle about the same size as the spore and sometimes with thin tapering hyphal projections, becoming empty and shrunken at spore maturity. Vesicle and hypha with hyaline to yellow walls 0.5-3µm thick. Spores 100-298 x 100-335µm, usually globose to subglobose but occasionally ellipsoid or reniform, dull yellowish brown to dark reddish brown, usually with part of the vesicle attached. Surface ornamented with crowded blunt spines 1-4µm high, 1µm in diam at the polygonal base, tapering to 0.5µm at the tip, separated by ±0.2µm, sometimes adhering in lines to form an irregular, partial reticulum on parts of the spore surface (visible only by scanning electron microscopy). Patches of hyaline to subhyaline amorphous material up to 2µm thick often irregularly encrusting the spines but rarely covering the whole spore surface. Spore wall continuous except for the occluded openings, three-layered: outer layer light yellowish brown to reddish brown, 4-10µm thick including spines and encrustations, enclosing two membranous hyaline walls, each 0.2-1µm thick, the inner wall usually slightly thinner.

DISTRIBUTION AND HABITAT: Abundant throughout the growing season in soil around roots of annual grasses, forbs, and trees on a sandy river terrace near the Des Moines River in central Iowa and present in small numbers in a heavy black soil in an old meadow near Rhodes, Iowa, in both sites associated with other endomycorrhizal Endogonaceae. Found in the wet subtropics of Veracruz State, Mexico, in soil beneath roadside grasses and weeds.

MYCORRHIZAL ASSOCIATIONS: Forms vesicular-arbuscular (VA) mycorrhizae with _Fragaria vesca_ L. in pot culture. Associated in the field with VA mycorrhizae of grasses, forbs, and trees (_Populus_ spp. and _Fraxinus americana_ L.).

Figures 1-6. _Acaulospora spinosa_ azygospores.
1. Scanning electron micrograph (SEM) showing globose form, surface ornamentation, and the occluded pore (arrow). 2. SEM showing part of vesicle adhering to the spore and spines joined in a partial, irregular reticulum. 3. SEM detail of the crowded spines with patches of amorphous deposits. 4. Azygospore attached to collapsed vesicle (arrow). 5. Subreniform spore, with the occluded pore (arrow). 6. Three layers of spore walls (arrows).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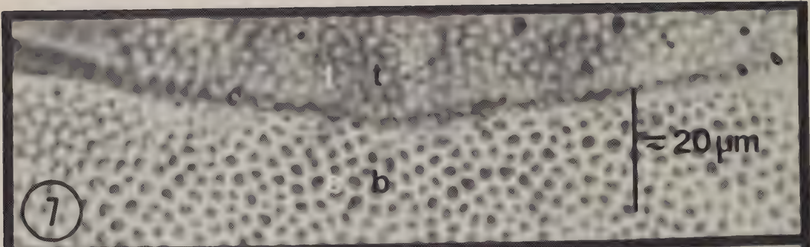
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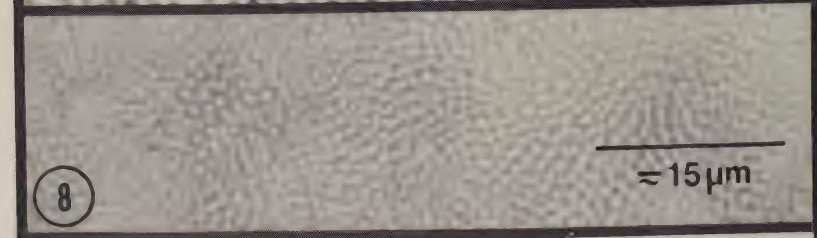
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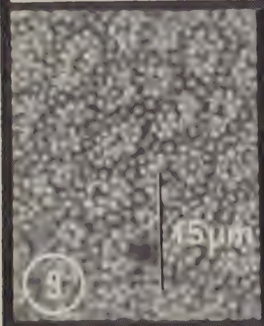
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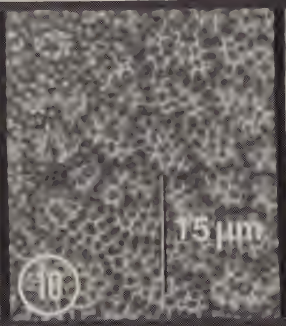
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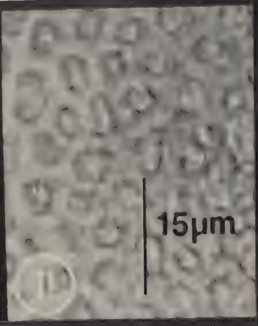
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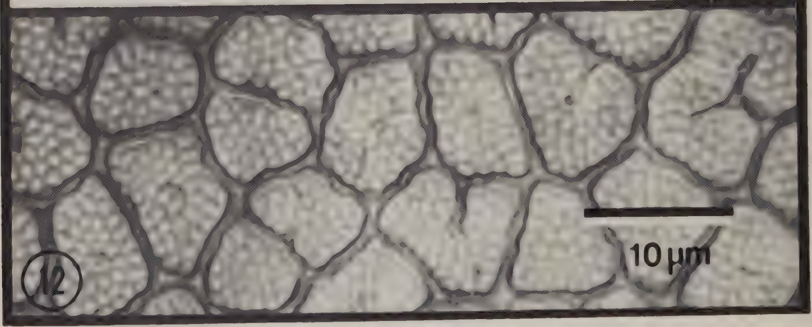
10 µm
12

ETYMOLOGY: Latin, spinosa, "spinose", in reference to the spore ornamentation.

COLLECTIONS EXAMINED: TYPE: U.S.A.: Iowa, Boone Co., 4-H Camp, 23 Aug. 1979, Walker #164 (OSC; isotype FH, ISC). PARATYPES: U.S.A.: Iowa, Boone Co., 4-H Camp, 3 Nov. 1978, Walker #68 (OSC). MEXICO: Veracruz, Tuxtla Biological Field Station, Univ. Nac. Auton. Mexico, Municipio San Andres, 9 July 1972, Trappe #3596 (OSC and ENCB).

The spores from Iowa are lighter colored and more yellowish brown than those from Mexico, which are generally deep reddish brown. This variation also occurs in A. laevis. The Mexican spores are generally somewhat larger than Iowa spores, though the ranges overlap considerably. We regard these modest differences as infraspecific variation.

A. spinosa resembles A. elegans Trappe & Gerd. but differs in lacking a complete reticulum superimposed on the spines at maturity (Figs. 7-11) and having only two thin inner walls (vs. three thickened inner walls in A. elegans). The two are difficult to distinguish at immature stages. A. bireticulata, the other species with an elaborate ornamentation of projections and reticulum, is readily differentiated from A. spinosa and A. elegans by its prominent three-layered reticular walls and stout, polygonal projections (Fig. 12).

KEY TO SPECIES OF ACAULOSPORA

Six species of Acaulospora have been discovered since Gerdemann and Trappe (1974) described the first two of the genus. Detailed descriptions can be found in the cited literature for each except A. foveolata, which will be published shortly.

Figures 7-12. Light micrographs of spore surfaces. (7-8) Acaulospora spinosa. 7. A cracked spore showing detail of spine tipe (t) and bases (b). 8. Lower magnification detail of tips of spines, showing swirled arrangement. (9-11) A. elegans. 9. Microscope focused on tips of spines. 10. Microscope focused on bases of spines to show reticulate appearance. 11. Microscope focused on reticulum overlaid on spines. 12. A. bireticulata, showing the reticulum and enclosed projections (photo by F. M. Rothwell, from Rothwell & Trappe 1979).

1 Spores less than 100µm broad, hyaline to very pale yellow; wall apparently single, roughened so minutely as to appear smooth..*A. trappei* Ames & Linderman (1976)

1 Spores broader than 100µm, hyaline to olive, brown, or dark reddish brown; wall with 2 or more layers; surface shiny-smooth or distinctly ornamented.........2

2(1) Spores shiny-smooth, globose to ellipsoid or reniform, 119-300 x 119-520µm, olive to yellowish brown or reddish brown; wall with a rigid outer layer 2-4µm thick and 2 thin inner layers.................................... *A. laevis* Gerdemann & Trappe (1974)

2 Spores distinctly ornamented.......................3

3(2) Spores with spines or polygonal projections, with or without a reticulum.................................4

3 Spores with pits or cerebriform folds, lacking a surface reticulum..6

4(3) Reticulum lacking; spores with crowded spines 0.5-2µm tall, sometimes overlaid with irregular, patchy hyaline encrustations..*A. spinosa* Walker & Trappe

4 Reticulum present; spore surface between reticulum walls with crowded spines or polygonal projections..5

5(4) Spore surface with crowded spines ± 2 x 0.5µm, with a hyaline, alveolate reticulum overlaid on the spines at maturity; reticulum walls 1-layered, ± 1µm thick; spores globose to ellipsoid, 140-285 x 145-330µm, olive to brown or reddish brown......................*A. elegans* ....Trappe & Gerdemann in Gerdemann & Trappe (1974)

5 Spore surface with polygonal projections ± 1 x 1µm, enclosed by a grayish green, alveolate reticulum with 3-layered walls 1.5-2µm broad; spores globose, 150-155µm in diam, light brown..*A. bireticulata* Rothwell & Trappe (1979)

6(3) spore surface with cerebriform folds up to 12µm tall; spores globose, 200-250µm in diam, brown; walls 2-layered, the inner layer reticulate............... *A. gerdemannii* Schenck & Nicolson in Nicolson & Schenck

6 Spore surface pitted............................7

7(6) Spores white to light olive brown, 100-240 x 100-220 µm, the surface with pits 1-1.5 x 1-3µm separated 2-4µm. ....*A. scrobiculata* Trappe (1977)

7 Spores dark reddish brown to nearly black, 200-260 x 220-260µm, the surface with pits 4-8 x 4-16µm irregularly separated by 1-12µm..*A. foveolata* Trappe sp. ined.

ACKNOWLEDGMENTS

Robert N. Ames, University of California, Berkeley, established *A. spinosa* in pot culture with strawberry after attempts at Iowa State University had failed. Joan Zito and Kathleen Bason, Iowa State University prepared the photographic plates of *A. spinosa* and *A. elegans*. Ned Klopfenstein, Iowa State University, assisted in the SEM studies. Dr. F. M. Rothwell, U.S. Forest Service, Berea, Kentucky, kindly provided the photograph of *A. bireticulata*.

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DISTRIBUTION OF AMANITA NAUSEOSA*

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Amanita nauseosa (Wakef.) Reid was described by Wakefield (1918) (as Lepiota nauseosa Wakef.) from a collection made in a greenhouse with exotic plants in the Royal Botanic Gardens at Kew, England. Reid (1966) reported this species from the same habitat and transferred the species to Amanita. Later, Guzmán (1975) described for first time A. nauseosa from a wild habitat at the edge of a tropical rain forest in the SE of Mexico.

Recently, Watling (1980) reported A. nauseosa from the Royal Botanic Gardens at Edinburgh also in a greenhouse. However, Watling doubts whether the Mexican material is conspecific with the Kew and Edinburgh material.Watling (1980) and Holden (1980) accepted the belief that Wakefield's fungus was introduced to Kew and Edinburgh from tropical regions through exotic plants.

Watling's doubts concerning whether the Mexican material of A. nauseosa is the same as that of Wakefield's and Reid's has no foundation, because as Guzmán (1975) stated, the Mexican material was checked with a collection from Kew sent to him and identified by Reid. All the macroscopic and microscopic features both in the English and in the Mexican material agree well. However, both collections have a membranous or floccose annulus on the stipe, a feature not reported by Wakefield (1918), Reid (1966) and Bas (1965). Surely the annulus is not of taxonomic value in this species because it is very friable and frequently lost in adult specimens.

Bas (1969) who revised the available collections of Amanita of the world, only reported A. nauseosa from Wakefield's and Reid's materials. Bas related A. nauseosa with A. aureofloccosa Bas, a species only known from the African Congo. It is interesting to observe that Pegler (1977) did not report either A. nauseosa nor A. aureoflo-

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ccosa from Eastern Africa, and Dennis (1970) did not report these species from Venezuela and adjacent countries. A. nauseosa is also close to A. praegraveolens (Murr.) Sing. only known from Florida (Bas, 1969) and a tropical locality in Mexico (Guzmán, 1975).

Consequently, the only report of A. nauseosa in a wild habitat is from Mexico, where Guzmán (1975) collected it in three localities in the State of Veracruz and one (Welden & Guzmán, 1978) in the State of Oaxaca. However, A. nauseosa is a very rare fungus in Mexico, because in spite of the numerous explorations made by the author in the American tropics in collaboration with Dr. A.L. Welden and his colleagues since 1976 to the present, the species has been found only four times. It is probable that this species also grows in the tropical forests of South America, mainly in Brazil where mycological explorations are very scarce at present. The introduction of A. nauseosa in Great Britain surely was through exotic plants taken from America. In this connection, Watling (1980) and Holden (1980) show that the introduction of Leucocoprinus birnhaumii (Corda) Sing., in Great Britain, a common tropical species in Mexico (Guzmán, 1979), was from the tropical region of Eastern Australia through exotic plants.

The author expresses his thanks to Dr. B. Lowy of Louisiana State University, for revising the text and improving the English.

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DIPODASCUS POLYPORICOLA NOV. SP., A PARASITIC HEMIASCOMYCETE ON *PIPTOPORUS SOLONIENSIS* (FR.) PIL.

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SUMMARY

Dipodascus polyporicola is described as new from *Piptoporus soloniensis* collected in Thailand. The host is reported as new to Southeast Asia and it is concluded that it is best placed in *Piptoporus*. A complete synonymy is reported for the host.

Among some fungi brought back from Thailand by one of us (T.S.) there was a polypore that macroscopically was almost identical with *Laetiporus sulphureus*. However, a microscopical examination revealed two startling facts. Firstly, the generative hyphae had clamps, which excluded *L. sulphureus* with its simple septate hyphae.

Secondly, and more exciting, the only fertile structures found in the hymenial tubes were asci containing ascospores. Basidia and basidiospores were totally lacking. Repeated examinations of sections taken on different parts of the specimens and in different depths of the tubes, gave the same result, no basidia, but an omnipresent, undifferentiated layer of septate hyphae producing asci. The outer parts of the tubes apparently had more asci than the inner parts. The polypore was obviously infected by a hemiascomycete, but looked otherwise healthy without colour-change or apparent distortions.

After having searched the literature in vain for a suitable name, pieces of the infected polypore were sent to different colleagues to see whether anyone had some knowledge about this parasite. The response was negative, but a possible relationship to *Dipodascus* Lagerh., *Endomyces* Reess, *Helicogonium* White and *Myriogonium* Cain was revealed, the two latter genera mainly because of their affinity to corticiaceous hosts.

It is well known that primitive ascomycetes may infect and parasitize basidiomycetes. In the family Endomycetaceae, the genus *Endomyces* is now circumscribed by the presence of naked, nonproliferating asci formed without visible conjugation on apparently diploid hyphae; hat-shaped, hyaline, gelatinous sheathed ascospores and the formation of an imperfect state of catenulate, cylindrical blastoconidia. In this circumscription the genus embraces three species, all growing parasitic on agarics (Redhead & Malloch 1977, von Arx 1977). Other species with naked asci from conjugating gametangial cells and with oval to ellipsoidal, sheathed ascospores, formerly placed in Endomyces, are by Redhead & Malloch (1977) referred to the three genera Zendera Redhead & Malloch, Galactomyces Redhead & Malloch and Magnusiomyces Zender and excluded from the Endomycetaceae. Von Arx (1977) disputed Redhead and Malloch's classification of these primitive ascomycetes and maintained that they should better be placed in the genus Dipodascus based on similar cultural and conidial characters. In his emended description of Dipodascus, the genus, with its broad concept, includes species with the typical arthroconidial form state Geotrichum; naked one-to many-spored asci formed from conjugating gametangial cells; ascospores hyaline to slightly pigmented, from ellipsoidal to almost spherical, ornamented or surrounded by a sheath. The members are commonly associated with animal or vascular plant exudates or extracts, but is so far not recorded as parasitic on fungi.

White (1942) described a primitive ascomycete parasitizing Corticium microsporum, apparently without any adverse effects on the host. It was placed in a new genus as Helicogonium jacksonii and characterized by the formation of naked asci from conjugating gametangial cells, asci with a thickened tip, multi-spored; and two-celled, oblong to fusoid unsheathed ascospores with secondary budding and the formation of secondary ellipsoid to cylindric ascopores while still in the asci. Cain (1948) came across another non-ascocarpous ascomycete while examining a collection of the corticiaceous Dacryobolus sudans and described it as Myriogonium odontiae. The new genus was characterized by asci produced in unilateral, cymose clusters from fusion of indifferentiated gametangial cells, giving rise to hyaline, one-celled, elongate-ovate unsheathed ascospores in a constant number of eight, which are liberated through an inamyloid broad pore at the tip of the asci.

After having compared the descriptions of the current non-ascocarpous ascomycete genera, we have come to the conclusion that the new species on Piptoporus soloniensis could best be placed in Dipodascus Lagerh. emend. von Arx, which was also suggested by von Arx (pers. comm.). The presence of ellipsoid, sheathed ascospores and asci developing from the fusion of two gametangial protuberances from two adjacent cells on the same or separate hyphae, indicate that Dipodascus is the proper genus (cf. Fig. 1.).

DIPODASCUS POLYPORICOLA Schum. & Ryv. nov. sp. Fig. 1.

Ascocarpa nulla. Asci sparsi vel dispersi, ex apicibus cellularum conjugantium evoluti qui seu vicini ex una seu ex

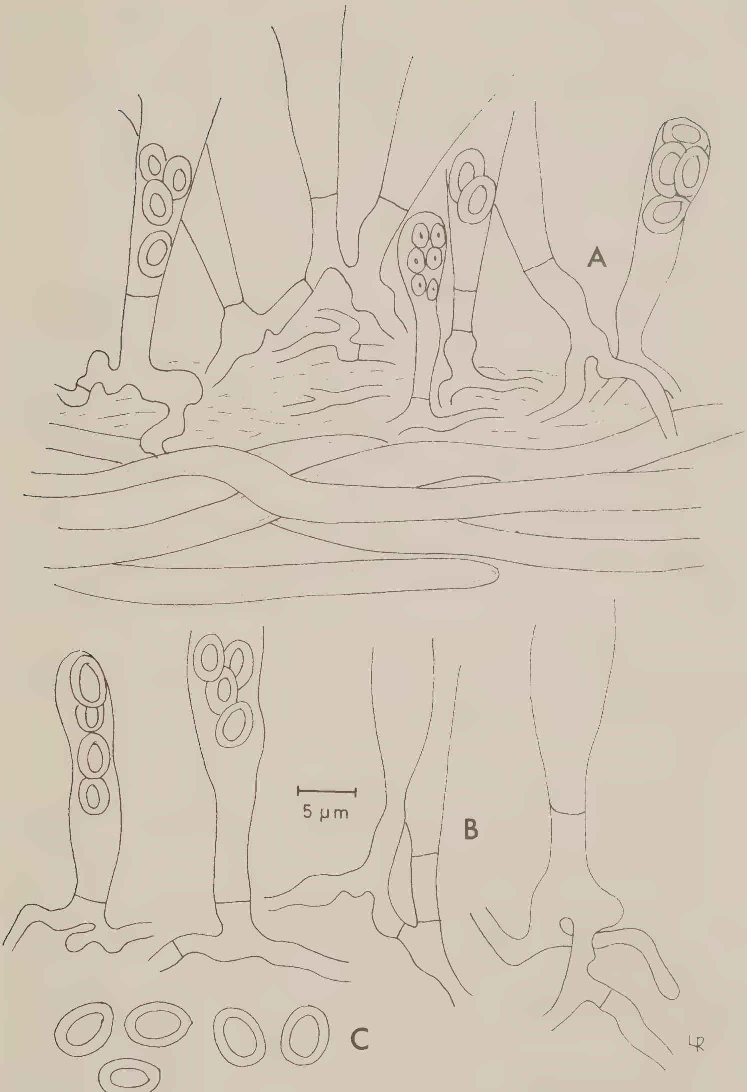

Fig.1. Dipodascus polyporicola. A) part of tubes with asci, B) asci, C) spores.

hyphis diversis oriuntur, asci clavatis vel subcylindraceis, 15-28 x 6-8 um, 4-6 (10) sporati, ad apicem dissolventes. Ascosporae ellipsoidei, hyalinae, strato mucilaginoso circumdatae, 4,5-6,0 x 3,0-4,8 um. Conidia non observantes. Habitat Piptoporus soloniensis (Fr.) Pil.

Type: Thailand. Cangwat Chiang Mai, Amphoe Mae Rim, Ban Kong Hae, 800 m a.s.l. in Dipterocarpus-forest, growing on Piptoporus soloniensis, 14. September 1978. T. Schumacher. TH 106. Holotype in herb. O, isotypes in K,CBS,DAOM,GB,CUP.

Ascocarp absent, asci single or in clusters, subconical to short cylindric, bifurcate at the base, 4-6(-10)-spored, developing from conjugation of gametangial protuberances which arise from two adjacent or separate hyphal cells, 15-28 x 6-8 um, ascospores hyaline, ellipsoid, smoothwalled, 1-celled, with a persistent mucilaginous sheath, inamyloid, 4.5-6.0 x 3.0-4.8 um inclusive sheath, when mature filling up the whole ascus, being somewhat polygonal in shape when densely packed. Conidial state not observed.

The ascopsores are liberated by the dissolving of the ascus-walls, and spores from adjacent asci accumulate in a mucilaginous spore ball attached to old ascus walls or hyphae. This type of spore liberation is indicative of insect dispersal, and insects are assumed to be the most possible vectors of the fungus in nature.

The species is obviously close to Dipodascus australiensis v. Arx et Barker (v. Arx 1977), described from rotting cladodes of the cactus Opuntia inermis. It is distinguished by smaller asci and ascospores and by its substrate.

The host of Dipodascus polyporicola was sterile, but its similarity to Laetiporus sulphureus soon lead to Polyporus trichrous Berk. & Curt. a prior name for P. pseudosulphureus Long (Lowe 1975).

However, the oldest name available to this taxon is Polyporus soloniensis Fr., published in 1821. Tortic (1975) in her discussion of P. schulzeri Fr. and its confused history, concluded that P. soloniensis should best be left in Piptoporus to which it had been transferred by Pilat (1936-42).

Piptoporus is typified by P. betulinus which has a soft and spongy consistency with a dimitic hyphal system as in P. soloniensis. A striking character of the latter is the skeletal hyphae, which partly dissolve in KOH. This is not the case with P. betulinus, at least not to a degree comparable with that of P. soloniensis. It is disputable how much taxonomic significance should be attributed to a character like this.

P. betulinus is glabrous with a papery thin, smooth cuticle on the pileus. P. soloniensis is first soft and dull, feeling velutinous when touched. With age the upper hyphae agglutinate and become pale dirty brown, and some sort of cuticle is developed, but it is never papery smooth as in P. betulinus. The spores of the latter are hyaline, non-amyloid and allantoid, while those of P. soloniensis are hyaline, non-amyloid but ellipsoid. At the generic level the spore shape is of little significance and there are several examples of accepted genera with a variable spore-form, such as, Tyromyces, Phellinus, Inonotus and Trametes, to mention some of the larger ones. In these genera there is also a considerable variation with regard to pileus cover and it seems appropriate to accept a certain generic variation in such macromorphological characters. If not, there will be an enormous proliferation of small genera which will only cause confusion.

Lowe (1975) placed P. soloniensis in Tyromyces which he gave a rather wide circumscription. The genus is typified by T. chioneus, a monomitic species or a few skeletal hyphae may occur. We feel that Tyromyces should be restricted to species with a predominantly monomitic hyphal system allowing for the presence of a few, scattered vegetative hyphae, apparently being developed rather late. P. soloniensis, with its almost total dominance of skeletal hyphae (generative hyphae can be very difficult to find), should be excluded from Tyromyces and left in Piptoporus.

P. soloniensis seems to be a very rare species everywhere. The last report from Europe seems to be the French collection mentioned by Tortic (1975:22) which was made in 1969.

A modern description of Piptoporus soloniensis is given by Lowe (1975), sub. T. trichrous. The synonyms of the host are cited below. If the type has been examined, the herbarium in which it is deposited is cited with an exclamation mark. The country of the type collection is given in parenthesis.

Piptoporus soloniensis (Fr.) Pilat
Atl. Champ. Europ. 3: 126, 1937. - Polyporus soloniensis Fr. Syst. mycol. 1:365, 1821. (France)-Polyporus trichrous Berk. & Curt. Ann. Mag. Nat. Hist. ser. 2 vol. 12:434, 1853 (USA) (K!)-Polyporus irpex Schulz. Verh. zool. bot. Ges. Wien 16:421, 1866 nomen nud. non. valid. publ. (Hungary). - Polyporus schulzeri Fr. Hymen. europ. p. 556, 1874. (renaming of P. irpex Schulz.) nomen illegit. non Kalchbr. 1868. - P. sublutescens Ellis & Everh. in Langlois Cat. Pl. Bas.-La. p. 33, 1887. (USA) nomen nudum non. valid. publ. - Polyporus pseudosulphureus Long. New Mex. Phi Kappa Phi 1:1, 1917 (USA) (BPI!). - Polyporus angolensis Lloyd Mycol. Writ. 6:997, 1920 (Angola) (BPI!). - Polyporus medullae Lloyd Mycol. Writ. 7:1330, 1924. (BPI!) (China).- Polyporus sambuceus Lloyd Mycol. Writ. 7:1360, 1925 (BPI!) (Japan)- Polyporus irpex Schulz. ex Krause, Arch. Ver.

Freunde Naturg. Mechlenburg II, 1:129, 1925 (validating Schulzers nomen nudum).

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Dr. J.A. von Arx, Dr. R.W.G. Dennis, Dr. J. Eriksson and Dr. R.P. Korf have examined the new species and given comments and advice. We greatly appreciate their stimulating help.

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REVUE DES LIVRES

par

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THE GENUS *PENICILLIUM* AND ITS TELEOMORPHIC STATES *EUPENICILLIUM* AND *TALAROMYCES*, par John I. PITT, viii + 634 p., 132 fig., in 8°, relié toilé, "1979" (publication date communicated by A.P. being 13.2.1980). Academic Press, 24-28 Oval Road, London NW1 7DY, UK. Prix: US 92.-.

Depuis 1949, le *Manual of the Penicillia* de Raper et Thom était la seule monographie relativement complète disponible pour l'identification des *Penicillium*. Elle reconnaissait 141 espèces et variétés.

Le concept générique de *Penicillium* supporté par Thom puis Raper et Thom voulant, en opposition avec l'art. 59 du Code de nomenclature, que seul le nom le plus ancien, qu'il soit anamorphique ou téléomorphique, couvre l'entièreté du champignon (l'holomorphe)(concept botanique des genres, voir Hennebert 1971), suscita d'autant plus d'opposition que le nombre de découvertes de *Penicillium* à fructification sexuée allait grandissant. Une revision s'imposait donc.

Pitt l'entreprit et la publie. Sa revision est caractérisée par trois traits: (1) le désir de conformité avec le Code de Nomenclature, du moins dans l'esprit, si ce n'est dans la lettre, (2) l'acceptation de 93 espèces des 141 espèces de Raper et Thom et l'addition de 57 autres espèces pour la plupart récentes, (3) l'emphase donnée sur la croissance en milieux de culture nouveaux et à différentes températures, sans s'attacher beaucoup plus que Raper et Thom à la morphologie.

Les 150 espèces reconnues par Pitt comprennent 37 *Eupenicillium* et 16 *Talaromyces* ayant une forme *Penicillium* pour anamorphe et 97 espèces anamorphiques de *Penicillium*.

Des 37 espèces incluses dans le genre *Eupenicillium*, 12 répondent à des taxa décrits dans Raper et Thom (1949), les 25 autres étant plus récentes. Du genre *Talaromyces*, l'auteur reprend 16 espèces à forme conidienne *Penicillium* (les espèces à anamorphe *Merimbla* et *Geosmithia* n'étant pas reprises), dont 9 espèces de Raper et Thom et 7 postérieures à 1949. C'est dire les progrès de ces dernières décades.

Le genre anamorphique conidien *Penicillium* Link ex S.F. Gray est divisé en 4 sous-genres, puis en sections et en séries. Le sous-genre *Aspergilloides* (25 espèces) ne comprend que les monoverticillés stricts à l'exclusion des *Ramigena* de Raper et Thom, soit 18 espèces de ces auteurs et 7 postérieures. Le sous-genre *Furcatum* Pitt regroupe les biverticillés, c'est-à-dire les *Ramigena* et les *Divaricata* de Raper et Thom ainsi que *Penicillium citrinum* qui dans les *Velutina* n'occupait qu'une place de transition. Des 27 espèces incluses, 5 seulement sont postérieures à 1949.Le sous-genre suivant, *Penicillium* sbg.*Penicillium*, regroupe les espèces triverticillées (ou bivertillées asymétiques) et comprend 22 espèces, dont 18 appartenaient aux *Velutina, Lanata, Funiculosa et Fasciculata* de Raper et Thom (des *Lanata et Funiculosa,* beaucoup d'espèces étant rendues synonymes aux autres). Ce sous-genre inclut *Penicillium expansum* lectotype proposé du genre. Le sous-genre *Biverticillium* Dierckx (23 espèces) regroupe 13 espèces des *Biverticillata symetrica* de Raper et Thom, 2 espèces réhabilitées de Dierckx et 8 espèces récentes.

On notera que les formes *Penicillium* des espèces d'*Eupenicillium* et *Talaromyces* ne sont pas reprises dans la classification générale des *Penicillium*, ni même mentionnées (à l'exception de trois, p.166-169) dans les clés dichotomiques des espèces.C'est regrettable d'autant plus que l'auteur voit dans la séparation des nomenclatures anamorphique et téléomorphique la possibilité d'aborder l'espèce par une seule de ses formes et ainsi arriver à son identification précise. Il est d'autre part curieux de constater que le traitement de *Eupenicillium* et celui de *Talaromyces* (dont l'un précède celui de *Penicillium* et l'autre le suit, on ne sait pourquoi) sont accompagnées de clés synoptiques chiffrées selon le modèle de Leenhouts, alors que le genre *Penicillium* est introduit par des clés dichotomiques. Pourquoi cette différence? Des clés synoptiques pour les *Penicillium* auraient beaucoup aidé à l'identification rapide.

Sur le plan de la nomenclature, Pitt s'efforce de suivre le Code Internationale de Nomenclature Botanique, ainsi fait-il, contrairement à Raper et Thom, une claire distinction entre la nomenclature des téléomorphes et des anamorphes. Cependant il s'en écarte, sans doute à bon droit, si ce n'était prématurément. En effet il suit la nomenclature qui devrait résulter de la conservation du genre *Penicillium* Link ex Gray (lectotype *P. expansum* Link ex Gray) contre *Penicillium* Fr. non Link (holotype *Mucor crustaceus* L.) selon la proposition 420 de Hawksworth, Pitt and Sutton in Taxon, 25:665-670, 1976. De plus il met déjà en application les propositions d'amendement de l'art. 59 par le Secrétariat de Nomenclature de l'Association Mycologique Internationale (Taxon 28: 424, 1979). Ainsi il recombine dans les genres téléomorphiques appropriés les 17 espèces décrites avec téléomorphe et classées par Raper et Thom dans le genre *Penicillium*. Cette prise de position hardie peut sans doute démontrer le bien-fondé et le bon fonctionnement de ces propositions.

Il n'en reste pas moins que la revision de Pitt exigera du taxonomiste habitué à la monographie de Raper et Thom un effort de réadaptation En plus des changements nomenclaturaux des espèces retenues, l'identificateur devra se convaincre de la synonymie des espèces rejetées. Un index donnant la redisposition des espèces de Raper et Thom pourra un peu l'aider, mais cet index est sans pagination. De plus, l'auteur a modifié les mileux de culture standards utilisés par Raper et Thom, y ajoute un troisième milieu et recommande leur usage à trois températures différentes. Cette exigence ne facilitera pas le passage d'une monographie à l'autre bien qu'elle soit acceptable.

L'auteur semble en effet mettre l'attention sur les caractères culturaux, en particulier la vitesse de croissance à différentes températures.On eut sans doute souhaité un approfondissement de l'étude morphologique et de la variabilité des espèces. Les descriptions morphologiques sont succintes. Les photographies, en microscopie interférentielle, excellentes pour la plupart, suppléeront, espérons-le, à la pauvreté des dessins.

Le livre est fort bien édité, comme il se doit. Cependant quelques imprécisions ou erreurs sont passées inapercues. Le Professeur Biourge est considéré le "student" de son élève Fr. Dierckx. Ceci est d'autant plus contraire à l'histoire que la plupart des souches étudiées par Dierckx lui avait été données pour étude par Biourge lui-même. Dierckx a élaboré son *Essai de revison du genre Penicillium* à la fois sous la direction et l'inspiration de Biourge qui s'y était attelé déjà depuis 1898. Je ne mentionnerai encore qu'une autre erreur, dans la diagnose du sous-genre *Furcatum* p. 233 où les "metularum" doivent être des "phialidum" pour que ce sous-genre regroupe des biverticillés.

Dans l'identification de champignons aussi répandus et aussi importants que les *Penicillium*, on est heureux d'accueillir l'ouvrage de Pitt, fruit de 10 années de travail difficile, louable effort vers une taxonomie et une nomenclature plus sûre de ces champignons.

ENTOLOMA (AGARICALES) IN INDOMALAYA AND AUSTRALASIA, par E. HORAK, Beihefte zur Nova Hedwigia vol. 65, 352 p., 234 fig., 19 pl.(8 pl. col.), in 8°, relié cartonné, 1980, J. Cramer ed., POB 48, D 3306 Lehre, Deutschland. Prix: DM 150.- (souscr. DM 120.-).

L'auteur nous est bien connu déjà pour l'importance de ses contributions à la flore mondiale des Agaricales (Mycotaxon 3(3):396). Il commença cette étude en Nouvelle-Zélande par la récolte de 1967 à 1969 de 50 espèces nouvelles d'*Entoloma*. Il explora ensuite Sri Lanka (Ceylan), Singapore et l'Indonésie mais dût compléter ses trop pauvres récoltes des collections de ces régions que lui offrit généreusement le Pr. E. Corner. Il explora encore la Malaisie, les îles Papua et Solomon, de 1971 à 1973. 234 Espèces d'*Entoloma*, pour la plupart nouvelles, sont décrites de ces régions, et l'auteur estime n'en décrire encore qu'une partie de la flore. Toutes ces récoltes ont été étudiées sur le frais, décrites et dessinées avec méthode (carpophore, cuticule, baside, spore, cystide). L'auteur suit les règles de la nomenclature, rejetant le nom *Rhodophyllus* Quel. Par ailleurs, il estime les sous-genres établis par Romagnesi et Gilles (1979) comme trop fragiles pour tenter d'y grouper ses espèces, à l'exception de *Claudopus, Richoniella* et *Pouzaromyces* qu'il trouve pratiques. Il lui importe plutôt de bien décrire les taxas. On regrettera qu'un erratum corrigeant d'autres erreurs que des coquilles ait dû être ajouté à un texte bien typographié et de lecture agréable.

A BIBLIOGRAPHY OF NORTH AMERICAN GASTEROMYCETES: I. PHALLALES. par William R. BURK, Bibliotheca Mycologica vol. 73, 216 p., in 8°, relié toilé, 1980, J. Cramer ed., POB 48, D 3306 Lehre, Deutschl. Prix DM 50.- (souscr. DM 40.-).

L'auteur inclut dans sa liste toutes les références, autant populaires que scientifiques, relatives aux Phallales (Clathracées et Phallacées) d'Amérique du Nord. Chaque référence s'accompagne de la liste des taxa traités et de leurs illustrations, ainsi que de leur distribution géographique.

CONTRIBUCIÓN AL ESTUDIO DE LOS *APHYLLOPHORALES* ESPAÑOLES, par M.T. TELLERIA, Bibliotheca Mycologica vol. 74, 464 p., 82 fig. (36 phot.) in 8°, relié toilé, 1980, J. Cramer ed. POB 48, D 3306 Lehre. Deutschland. Prix DM 100.- (souscr. DM 80.-).

Dans un système taxonomique moderne des *Aphyllophorales*, l'auteur présente un relevé actuel de la flore d'Espagne basé sur des récoltes récentes et anciennes. Le relevé couvre l'ensemble de la péninsule à l'exception de la Catalogne, de l'Andalousie orientale, de la Galicie et des Asturies dont le relevé est seulement bibliographique. L'ensemble couvre 15 familles, 114 genres, 260 espèces dèsquelles 81 sont nouvelles pour l'Espagne. Le système taxonomique est étayé de bonnes descriptions et remarques sur la distribution géographique, illustré de cartes et appuyé de clés dichotomiques des familles, genres et espèces. L'intérêt de l'ouvrage, évident pour la flore espagnole, dépasse de beaucoup ce cadre par la valeur de la taxonomie proposée comme une synthèse de la taxonomie des *Aphyllophorales* de Donk (1933-1958) et des apports plus récents tels les *Corticiaceae* de Erisson et Ryvarden (1973-1978) et les *Polyporaceae* de Ryvarden (1972-1978). Le livre est en espagnol, les clés dichotomiques sont aussi en anglais.

UNTERSUCHUNGEN ZUR GENETIK DES FORTPFLANZUNGSVERHALTENS UND DER FRUCHTKÖRPER- UND ANTIBIOTIKABILDUNG DES BASIDIOMYCETEN *AGROCYBE AEGERITA*, par F. MEINHARDT, Bibliotheca Mycologica vol. 75, 128 p. 5 fig., 14x22 cm, dos papier, 1980, J. Cramer ed. Prix DM 40(32).

La propagation végétative de *Agrocybe aegerita* est déterminée par une incompatibilité homogène dans le cadre d'une sexualité tétrapolaire, réglée par 2 gènes indépendants A et B dont l'ordre peut varier de race à race. Etudiant 2 races différentes l'auteur définit les types compatibles de croisement. La fructification du champignon, d'autre part, est réglée par 3 gènes, un gène Su permettant la fertilité des dicaryote, un gène Fi déclanchant l'initiation du carpophore et un gène Fb réglant sa différenciation. Appliquant ces résultats, la caractérisation précise des souches permettra d'obtenir à coup sûr des fructifications. Cette thèse a été réalisée sous la direction du Pr. Karl Esser.

STUDIES ON THE TOLERANCE TO ELEVATED TEMPERATURE IN *PLEUROTUS OSTREATUS* (Jacq. ex Fr.)Kummer. A CONTRIBUTION TO TAXONOMY AND THE GENETICS OF THE FRUITING PROCESS. par SUI LONG LI, Bibliotheca Mycologica vol. 76, 86 p. 11 fig., 17x22cm, dos papier, 1980, J. Cramer ed., DM

Cette thèse réalisée à l'Université de Marburg sous la direction du Pr. G. Eger-Hummel, apparaît importante pour la génétique de *Pleurotus ostreatus* et la sélection de souches adaptées aux méthodes de culture industrielle. L'auteur, étudiant les monocaryons et dicaryons de souches à optimum thermique élevé (Floride) et bas (Europe) et de leurs hybrides démontre l'existence de 7 gènes commandant la croissance mycélienne selon la température et un gène unique Ft réglant, en fonction de la température, le développement du carpophore, de sa couleur et de sa texture. De cette manière l'auteur démontre l'identité spécifique entre souches de haute et basse température et la synonymie d'espèces telles que *P. pulmonarius* Fr., *P. sapidus* Kalchbr. à *P. ostreatus*, les conditions climatiques faisant prévaloir de maintien de génotype à optimum haut ou bas suivant les régions.

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INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME TWELVE

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ERRATA, VOLUME ELEVEN

Page 290, lines 34-37, final words: *for* N 1. isoneotyp Exsi
read Neo- 1230 isoneotypes Exsic-
411, line 1: *for* DEVELOPEMENT *read* DEVELOPMENT
414 7: *for* (Fig. 3) *read* (Fig. 9)
10: *for* (Fig. 2), *read* (Fig. 8),
443 26: for *C.* read *Chaetosphaeria*

ERRATA, VOLUME TWELVE

Page 1,	line 10:	*for* sphaeriales *read* sphaerales
8	11:	*for* Lating *read* Latin
12	5:	for *Pseudobalsmia* read *Pseudobalsamia*
	27:	for *Galactomyces.* read *Dipodascus.*
14	13:	for *aveolata* read *alveolata*
16	18, 20:	for *Ascodesmus* read *Ascodesmis*
17	5:	*for* conbination *read* combination
	13:	for *Malbranchia* read *Malbranchea*
	34:	*for* Arachnioideae *read* Arachniotoideae
18	2:	*for* Arthrodermoideae *read* Arthrodermatoideae
	14:	*for* ARACHNIOIDEAE *read* ARACHNIOTOIDEAE
19	11:	for *Arachiotus* read *Arachniotus*
	31:	*for* ARTHRODERMOIDEAE *read* ARTHRODERMATOIDEAE
22	21:	delete *eberhardtii*
25	26:	*after* =Eurotiaceae *add* Clements & Shear, Genera of Fungi, p. 50, 1931.
26	13:	for *Emericalla* read *Emericella*
	25:	*for* ear. *read* eae.
	27:	for *Aspergillua* anamorphs, *Sago-* read *Aspergillus* anamorphs, *Sage-*
	28:	for *nema* read *noma*
31	42:	FOR *sulfurea.* For those remaining genera READ *sulfurea,* that include
36	19:	*for* ASCOSPHAERIALES *read* ASCOSPHAERALES
39	24:	*for* here. *read* there.
45	4:	for *Lophotricus* read *Lophotrichus*
45	17:	for *cum poris* read *sine poris*
	26:	*for* with germination *read* without germination
48	30:	*for* homonym *read* synonym
52	34:	for *Ceratocysis* read *Ceratocystis*
54	14:	*for* Muller *read* Müller
57	45:	*for* concieved *read* conceived
59	17:	for *Ascodesmus* read *Ascodesmis*
61	2:	for *Fleishhakia* read *Fleischhakia*
62	5:	for *ponese* read *ponense*
66	29:	for *Plectolitus* read *Plectolithus*
71	19:	for *Xenophilia* read *Xenophila*
	41:	for *Lepidosphaera* read *Lepidosphaeria*
86, col.	2:	*for* ASCOSPHAERIALES *read* ASCOSPHAERALES *for* Ascosphaeriaceae *read* Ascosphaeraceae
87	1:	for *Triptosporella* read *Tripterosporella*
	2:	for *Richingerella* read *Rechingerella*
	3:	for *Fleishhakia* read *Fleischhakia* for *Puressiella* read *Preussiella* for *Ceratocarpis* read *Ceratocarpia*
91	1:	FOR *Sagenoma* 26, 68, READ *Sagenoma* 26, *30*, 68
98, line	13:	for *Termitaria* read *Termitariopsis*
115	36:	for H. solida read Heterocephalacria solida
139	13:	for *B.* read *Boerlagiomyces*
147	36:	for *A.* read *Acanthostigmina*
163	19:	for *Acanthostigma minuta* read *Acanthostigma minutum*
	21:	for *Acanthostigmina minutum* read *Acanthostigmina minuta*
255	11:	for *brasiliensis* read *brasiliense*
	27:	*for* (Dumont, 1980) *read* (Dumont, 1981)
256	30:	for *brasiliensis* read *brasiliense*
261	48:	for *brasiliensis* read *brasiliense*
272	24:	for *siliensis* read *siliense*
277	20:	*insert* ____. 1981. (In press, Mycotaxon 12: 313-371.)

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